Virginia's 2015 Wildlife Action Plan

Prepared by the Virginia Department of Game and Inland Fisheries

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FOREWORD

My Fellow Virginians;

Looking back upon its first century, the Virginia Department of Game and Inland Fisheries (DGIF) can be proud of many remarkable accomplishments. DGIF worked with partners and landowners to restore white-tailed deer, waterfowl, beavers, trout, turkey, bald eagles, freshwater mussels, grouse, and dozens of other species native to Virginia's rivers and landscapes. Over 203,000 acres have been conserved as Wildlife Management Areas to provide both wildlife habitats and outdoor recreation opportunities. The Department worked with countless private landowners to create and restore critical wildlife habitats that enhance the quality of life that Virginians enjoy. At the beginning of the 21st century, wildlife remains a public priority.

However, in this new century, the challenges facing wildlife are becoming ever greater. Increasing demands are being placed on our habitats. New wildlife diseases and invasive species arrive in Virginia every year to threaten our economy and strain the Commonwealth's wildlife and habitats. These and other challenges require that we remain ever vigilant in protecting the wildlife that we all cherish.

Virginia's Wildlife Actin Plan was written to offer strategies for rising to the challenges of the 21st century. This Plan describes opportunities to maintain and improve our natural habitats, allowing us to conserve wildlife in ways that benefit people. This Plan provides common sense alternatives that focus on efforts to restore our rivers, maintain our forests, and prevent species from declining to the point where federal protections are imposed. It uses the best available science to describe practical actions that we can take to help our wildlife and our human communities adapt to changing conditions. Most importantly, this document demonstrates that some of our most critical conservation issues can be addressed in a cost-effective way using proven techniques and technologies.

Virginia's Wildlife Action Plan also challenges us to recognize the issues that threaten the Commonwealth and our wildlife heritage and then act to prevent those problems as we move forward. As Virginia begins our second century of wildlife conservation, it is my hope that this Action Plan will inspire all Virginians to work together to conserve our wildlife and preserve our habitats.

Yours in Conservation,

Bob Duncan
Executive Director
Virginia Department of Game and Inland Fisheries

PREFACE

When I came to Virginia in 2007, there was a genuine expectancy about the Wildlife Action Plan. During 2004 and 2005, thousands of work hours had been dedicated to draft this document which was the first of its kind for the Commonwealth. As Secretary Murphy indicated within the foreword, the first Action Plan worked to weave together a diversity of resources and craft a plan for the entire conservation community. In many ways, Virginia's 2005 Wildlife Action Plan was a raging success. It was nationally recognized for its quality and has been instrumental in implementing important research projects, land acquisitions, habitat restorations, and species reintroductions. Despite those successes, in 2007, there was also a feeling that more could be accomplished and that the Action Plan could play a greater role in the conservation of Virginia's wildlife and habitats.

To orient myself to the situation, I spent the next several months interviewing biologists, administrators, partners, and other conservationists involved with the 2005 effort. During those interviews, several issues became clear. First, in an effort to accommodate all conservation priorities, the first action plan failed to adequately prioritize the various threats impacting wildlife and habitats and the actions that were needed to keep species from becoming endangered. Second, concerns about climate change were increasing and the action plan wasn't prepared to provide significant guidance on that issue. Finally, as local conservationists worked to implement projects, the Action Plan wasn't providing the types of detailed, locally relevant, guidance that they needed. As one person said, "I really like the idea of the action plan, but I don't understand what it is asking me to do." These observations were offered constructively by partners and staff that were dedicated to the action plan's implementation. While these individuals may not remember those conversations, their insights served as the foundation for the 2015 update. The planning team and I have worked hard to learn from the last decade of implementation and create a more robust action plan that is more locally relevant, identifies specific conservation priorities, and describes ways to address the impacts climate change and other issues will have on Virginia's wildlife and habitats.

This has been a significant undertaking that could only be achieved via the dedication and determination of many. While all efforts are appreciated, the authors would like to extend a special thank you to a number of individuals for their contributions to this action plan. These individuals include:

- The staff and administrators from the Virginia Department of Game and Inland Fisheries' Bureau of Wildlife Resources - Scores of you contributed your time and expertise to help us identify and prioritize the species of greatest conservation need, understand the habitats those species require, describe the threats impacting those species and habitats, and articulate the actions that can be taken to address those threats and help keep species from becoming endangered. Many of you reviewed draft materials, corrected our mistakes, and helped arrange outreach opportunities. Without your efforts and expertise, the updated action plan would not exist as a viable conservation tool.

- Scott Klopfer, Austin Kane, Rebecca Schneider, Ed Laube and other staff at Virginia Tech's Conservation Management Institute - You have been invaluable members of this planning team who have helped craft a viable conservation plan from a series of vague goal statements and general ideas of how things should be done.

- Chris Ludwig, Jason Bullock, and other staff at the Virginia Department of Conservation and Recreation's Natural Heritage Program - Your generosity and collaborative nature have been greatly appreciated. The data, tools, and analyses you provided were critical in identifying and describing conservation priorities and opportunities.

- Danette Poole and Janit Llewellyn at the Virginia Department of Conservation and Recreation's Recreation Planning office - The format pioneered within the Virginia Outdoors Plan has made the Wildlife Action Plan much more actionable and relevant to members of Virginia's conservation community. Your insights and support have been greatly appreciated.

- Dee Blanton and others from the U.S. Fish and Wildlife Service's Wildlife and Sportfish Restoration Program – Your efforts to help the northeastern states communicate with each other and coordinate with the North Atlantic Landscape Conservation Cooperative have advanced our planning efforts and will enhance our collective ability to address our regional conservation needs.

- Andy Hofmann and colleagues at the U.S. Fish and Wildlife Service's Eastern Virginia Rivers National Wildlife Refuge Complex and Roberta Hylton and colleagues with the U.S. Fish and Wildlife Service's Ecological Services Program – Your thoughtful comments, questions, and insights have improved the action plan, in innumerable ways, by helping us consider conservation issues at local, state, national, and international scales.

- Carol Croy and staff from the George Washington and Thomas Jefferson National Forests – Thank you for all the information you provided and your patience in helping us understand how to incorporate your efforts into the new Action Plan

- Dean Cumbia and Rob Farrell and staff and administrators from the Virginia Department of Forestry – Thank you for your insights and assistance in crafting a plan that will implement actions that are good for both wildlife and people.

- Nikki Rovner, Judy Dunscomb, Mark Anderson, Erik Martin and others from TNC – The models, analyses, local insights, and discussions helped us create a more robust action plan that will be relevant at local, state, and regional scales.

- Lastly, the authors would like to thank everyone that reviewed the draft Action Plan and provided comments. We appreciated the words of encouragement as well as the constructive criticisms.

Throughout this planning effort, I have been amazed by the caliber and diversity of conservation efforts being implemented in Virginia. Likewise, I have been humbled by how generous people with been with their time, tools, insights, and information. Although our missions may not be identical, they are most certainly complementary and compatible. As the writing of this Action Plan comes to a close, I am increasingly excited to begin implementing this plan. I can't wait to see what we can accomplish together.

Sincerely,

Thomas C Burkett (Chris)
Wildlife Action Plan Coordinator
Virginia Department of Game and Inland Fisheries
August 31, 2015

EXECUTIVE SUMMARY

Virginia is an incredibly diverse state. While supporting over 8 million people, Virginia's landscape provides hundreds of habitat types that support tens of thousands of wildlife species. Throughout Virginia's history, these wildlife and habitat resources have provided Virginians with subsistence, economic benefits, and recreational opportunities that contribute to community wellbeing and individual quality of life.

Over the last century, Virginia's habitats have become increasingly impaired, impacting both wildlife and people. While Virginia's conservation community has successfully restored many imperiled species, including white-tailed deer, Canada geese, and bald eagles, many habitats and the species they support continue to decline. At the time of this writing, over 130 species have been classified as being either threatened or endangered in Virginia. While this list of species grows, efforts to restore critically imperiled species are becoming more expensive, politically contentious, and biologically challenging. Limited budgets, habitat loss, climate change, and a diverse suite of political and economic interests require Virginia's conservation community to reconsider their work; to become more collaborative and proactive. It is no longer sufficient to ask, "How do we restore endangered species?" Rather, the conservation community must ask, "How do we keep species from becoming endangered?" Virginia's Wildlife Action Plan presents a strategy to help restore critically imperiled species and prevent declining species from becoming endangered, while also providing benefits to Virginia's human communities.

The updated Action Plan identifies 883 species that are either critically imperiled or in decline. Habitat loss is the single greatest challenge impacting these species. The Action Plan identifies strategies to conserve and restore these species. In addition to a statewide overview, the Action Plan describes strategies for 21 multi-county planning regions which are roughly consistent with Virginia's Planning District Commissions. For each planning region, the Action Plan identifies the local wildlife priorities, the habitats those species rely upon, threats impacting these species and habitats, and conservation actions that can be taken to address those threats. The Action Plan identifies: priority places for either conservation or restoration within each planning region, programs working to address threats or define best management practices, and data that could be used to document and evaluate the success of conservation actions. Finally, the updated Action Plan describes climate trends that have been projected for Virginia and identifies actions that can be taken to conserve wildlife under changing climatic conditions.

Virginia's Action Plan was updated with significant input from Virginia's conservation community. Substantial efforts were also made to obtain feedback from the local landuse planning authorities and the general public.

It is hoped that this updated Action Plan will help Virginia's conservation community expand and enhance existing partnerships, develop new partnerships, direct the use of existing conservation resources toward priority areas and problems, and help the Commonwealth acquire or develop new human and financial resources to address these important conservation issues.

1. INTRODUCTION

BACKGROUND

In 1973, President Nixon signed the federal Endangered Species Act (ESA) into law, which declared that preventing species from becoming extinct would be a national priority. With funding provided by the U.S. Fish and Wildlife Service (USFWS), this legislation had a dramatic impact on wildlife conservation in North America. Now, in addition to programs managing game species, resources and personnel were also allocated to address the needs of nongame species. Over the next four decades, the conservation community achieved remarkable successes such as conserving the bald eagle, the American alligator, and the grizzly bear. While enjoying these successes, the conservation community also found itself at the center of intense disputes as efforts to conserve the northern spotted owl and to reintroduce the gray wolf to the northern Rocky Mountains divided communities and enflamed political rhetoric. Lastly, some species, such as the dusky seaside sparrow, became extinct despite of the protections the ESA provided.

Since the 1970's, state wildlife agencies have learned many important lessons. First, working to restore an endangered species can require decades of work and tens of millions of dollars. Second, by the time a species is declared to be endangered, populations have often declined to a point where conservation may not be possible. Third, once endangered, there are likely a limited number of individuals left and regulations put in place to protect the species may also reduce or prevent innovative approaches to restoration. Finally, an endangered species crisis, played out in the media, can require years of effort that do not address the underlying conservation problems in a proactive and collaborative manner. In the early 1990s, the Association of Fish and Wildlife Agencies (AFWA) described the federal ESA as an "emergency room" for species in crisis (Belanger and Kinnane 2002). Further, AFWA indicated this "emergency room" was often needed, but also expensive and stressful for both property owners and conservationists (Belanger and Kinnane 2002).

State agencies have collaborated with AFWA since the 1990s to develop proactive programs to help keep species from becoming endangered. As part of this effort, AFWA and the states worked with Congress, the White House, the USFWS, and thousands of stakeholders to develop a new funding mechanism to support this strategic conservation effort. In 2000, Congress created the State and Tribal Wildlife Grants (SWG) program to help state and tribal wildlife agencies work with at-risk species and prevent endangered species listings. This program currently provides funding to all 50 states, the five U.S. Territories, and the District of Columbia, making the SWG Program an invaluable conservation resource.

As a condition for receiving SWG funding, Congress mandated that each state and territory develop Wildlife Actions Plans (Action Plans) by October 2005. The Action Plans were conceived as an effort to guide states in identifying and addressing the needs of a wide array of wildlife and habitats of greatest conservation need. These Action Plans were also used to ensure the effective use of SWG funding. To guide development of these Plans, Congress established Eight Essential Elements that had to be addressed before an Action Plan could be approved by the Director of the USFWS (Public Law 106-291). These Eight Essential elements include:

1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and

2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and

3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and

4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and

5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and

6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and

7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats; and

8. Congress has affirmed through the Wildlife Conservation and Restoration Program and SWG that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

All states and territories submitted their Action Plans to the USFWS by October 1, 2005. Since being approved, these Action Plans have been a guiding force in wildlife conservation. Virginia's 2005 Wildlife Action Plan represented a strategy to conserve Virginia's wildlife resources. Although DGIF was the lead agency in developing the Action Plan, it was intended to be a strategy for statewide wildlife conservation and a framework for coordination and cooperation between agencies, academics, communities, and private conservation groups. DGIF and partners have used the Action Plan to identify key species and habitats in need of conservation and implement projects and research needed to address those issues on behalf of all Virginians.

Virginia's Action Plan is scheduled to be updated every 10 years. DGIF and partners view this update process as an important opportunity to reevaluate the status of species of greatest conservation need (SGCN) and their habitats, review conservation priorities, and reprioritize conservation actions. Furthermore, this update provides a process to review the conservation efforts, research, and projects implemented during the past decade. It also allows DGIF and partners to consider how the Action Plan and project prioritization might be improved to enhance efforts that keep species from becoming endangered. Based upon discussions with DGIF staff and conservation partners, Virginia's Action Plan

has been modified in several important ways. First, the updated Action Plan adopts a greater emphasis on habitat conservation. While single species efforts may be necessary to conserve the most critically imperiled species, scores of other species can be effectively and efficiently conserved via actions that protect and restore the quality of their habitats. Second, the new Action Plan also adopts the format used by the Virginia Outdoors Plan that communicates priority actions and needs at the local level (multi-county jurisdictions) (DCR 2013). By providing chapters for each of the 21 planning regions in Virginia, which are roughly analogous to Virginia's Planning District Commissions, it is hoped this new Action Plan will be better able to facilitate conservation actions among a diversity of conservation partners. The third major change focuses on enhancing species prioritizations. In addition to describing species' level of imperilment, the new prioritization scheme applies a triage approach to consider what actions can be taken to address threats to a species and its habitats. Finally, the Action Plan will be available in a more accessible format and develop a greater online presence. By enhancing its availability, it is hoped the Action Plan will be used by a greater diversity of land use and conservation partners throughout the Commonwealth.

2005 Wildlife Action Plan Implementation

Over the last decade, Virginia's Wildlife Action Plan has become an important conservation resource and significant effort has been expended to address issues identified within its pages. Successful implementation of the Action Plan can be categorized into four main areas of work: species research, active resource management, land acquisition, and support and planning.

Species-specific research efforts have focused on helping Virginia's conservation community better understand the distribution, taxonomy, habitat requirements, and life history of a diverse set of SGCN. These data have been critical in helping biologists develop or improve species management efforts. State Wildlife Grant resources were used to develop a conservation strategy for the canebrake rattlesnake – a critically imperiled species impacted by habitat loss in south east Virginia. Joint research with the National Park Service resulted in a management agreement with Shenandoah National Park to manage the endangered Shenandoah salamander and may allow this amphibian to be removed from the federal list of endangered species. Finally, in a few cases, baseline surveys have identified previously unknown populations, indicating that species like the Dismal Swamp Southeastern Shrew, the southern bog lemming, the spotted margined madtom, the Teays River crayfish, and the stargazing minnow are more secure than previously thought and do not need to be included within Virginia's next Action Plan.

Other conservation management efforts have had a more direct and immediate benefit to SGCN and habitats within the state. Virginia was the first state to eradicate a population of non-native invasive zebra mussels that, if left unattended, could have devastated aquatic habitats and freshwater mussel populations. DGIF staff and partners implemented a predator control effort on Virginia's barrier islands that benefited dozens of beach nesting SGCN birds and the northern diamond-backed terrapin. Partnerships with municipalities and landowners focused on removing dams, improving water quality, and restoring riparian habitats along the James, Powell, and Rappahannock rivers. Finally, Virginia is a leader in the propagation of imperiled freshwater mollusks in the Tennessee River and the Atlantic slope watersheds.

Important lands were acquired to conserve SGCN and their habitats. The 750-acre Cavalier Wildlife Management Area (WMA) provides a variety of forested and open habitats utilized by SGCN as diverse as canebrake rattlesnakes and neotropical migrant songbirds. The Cavalier WMA also provides Virginia's

best opportunity for restoring a stand of Atlantic white cedar, a once common but now rare forest type, known to support several SGCN. The 2,500 acre Mattaponi WMA was purchased in cooperation with Fort AP Hill and other partners and provides a diversity of aquatic and terrestrial habitats that support almost 60 SGCN species. While these efforts are expensive, they represent a permanent conservation achievement.

The last category of activities involves a range of support and planning services. The original Action Plan frequently described how devastating the loss or degradation of habitats can be to species. Often these impacts are caused by human activities. DGIF's Environmental Services Section has incorporated the Wildlife Action Plan into their review and commenting process for construction or development projects. Likewise, the Virginia Fish and Wildlife Information Service, Virginia's comprehensive wildlife database, has embraced the Action Plan and works to provide a variety of distribution, habitat, and conservation information about the SGCN. Finally, climate change was identified as a significant threat to several Action Plan species. Since, 2008, Virginia has been a leader in working to develop strategies that address climate change within the updated Action Plan.

Undoubtedly, the original Action Plan has helped Virginia conserve SGCN. However, in discussions with DGIF staff, partners, and members of the public, a variety of concerns were identified as impediments to its full implementation. The updated Action Plan will address the identified weaknesses while allowing the conservation community the opportunity to evaluate this conservation tool and adapt efforts to meet new needs and challenges.

GOALS FOR THE UPDATED WILDLIFE ACTION PLAN

The primary purpose of this updated Action Plan is to identify conservation actions that will benefit a diversity of species and habitats and describe where those conservation actions should be implemented. Based on the extensive work to implement the first Action Plan, several key lessons and concerns emerged to inform the update process. First, the original Wildlife Action Plan was organized by ecoregions. Each ecoregion chapter included background information on the ecoregion and more specific details for a selection of SGCN found within the ecoregion (e.g., species life history, habitat description and status, threats, conservation actions, and research and monitoring needs). The ecoregion sections were informative and included relevant information for some species. Unfortunately, none of Virginia's conservation partners manage resources based upon ecoregion boundaries, making the 2005 Action Plan less "actionable" than was desired.

A second concern involved the prioritization of projects implemented from the Action Plan and how those efforts related to conservation partners. Much of the implementation has focused on single species survey and research efforts. The majority of these efforts focused on species that were already critically imperiled and this prioritization prevented many DGIF divisions and staff from aligning closely with the Action Plan. Likewise, partners that were not specifically focused on threatened and endangered species were less able to identify actions applicable to their work.

Finally, there were concerns over the depth and efficacy of the conservation goals that were identified in the original Action Plan. DGIF recognizes the importance of developing a more robust set of priorities. With the first Action Plan important and necessary actions were outlined but without any specific prioritization. While this strategy provided great management flexibility, it also resulted in a degree of confusion as to which actions should be addressed first.

Based upon these lessons, the five primary goals for the next Action Plan include:

- *Using a habitat approach to address threats and conservation issues* – The revised Action Plan focuses conservation efforts at the habitat level in order to address threats and conservation issues for a broader array of SGCN.
- *Being relevant at a more local geographic scale* – The updated Action Plan is written to provide resource managers with information about priority species, habitats, threats, and conservation actions in their area of focus and influence.
- *Prioritizing species and actions* – The updated version of the Action Plan places a focus on prioritizing both SGCN and conservation actions at a local level. In this way, conservation within Virginia can be carried out in areas in the most need of action or areas where efforts are most likely be successful/ beneficial.
- *Representing an array of partners* – The contents of this Action Plan focus on SGCN and habitats that are managed by a diversity of federal, state, and local agencies as well as private organizations and individuals that implement conservation efforts throughout Virginia. Whenever possible, relevant tools and priorities developed by these partners have been incorporated into the Action Plan.
- *Emphasizing effectiveness* – The Action Plan includes specific procedures that will allow DGIF and others to measure the effectiveness of conservation actions implemented from the Action Plan.

VALUE OF AN UPDATED ACTION PLAN

Virginia has a vast array of biodiversity and habitats from the coast to the mountains. Natural resource conservation in Virginia, as in most states, is tackled by government agencies, non-governmental organizations, private institutions, and public citizens. This conservation community collaborates across the Commonwealth to maximize the opportunities for conserving wildlife and habitats. Virginia's Action Plan provides a statewide and local blueprint for conservation actions needed to keep species from becoming endangered. Information regarding these resources is provided at multiple levels, ranging from single species needs to habitats and watersheds. The Action Plan is designed to help all conservation actors understand species and habitats priorities at a state and local levels and the types of actions needed within their area of responsibility or even backyard. The Action Plan includes 883 SGCN; it covers over 13 habitat types; and it is divided into 21 individual Local Action Plan Summaries that include priority SGCN and threats and conservation actions by habitat.

The process of updating this Action Plan allowed federal, state, and local agencies as well as nonprofit organizations, academic institutions, and other entities to identify common goals and actions that will help all players work more efficiently at achieving conservation success. This Action Plan is meant to build upon existing partnerships, enhance and prioritize programs, build support for the identified priorities, and lay the foundation for effectively and efficiently implementing conservation actions throughout the Commonwealth.

UPDATED PLAN STRUCTURE

The updated Action Plan has two main sections – the introductory and statewide materials followed by a series of multi-county Local Action Plan Summaries, with the latter forming the bulk of the document. This format is a significant departure from Virginia's first Action Plan's structure. After vetting this new model with DGIF staff and administrators, staff from state and federal agencies, partner organizations, and a handful of municipalities, this new structure was created to better facilitate the implementation of conservation actions. The Eight Essential Elements required of every Wildlife Action Plan are addressed within various sections as indicated below:

- *Introduction* provides background information and an overview of the Wildlife Action Plan.
    - Purpose of Wildlife Action Plan
    - Implementation of 2005 Action Plan
    - 2015 Wildlife Action Plan Goals
    - Wildlife Action Plan Value
    - Plan Structure
- *Methods and Approach* (Elements 5, 6, 7, and 8)
    - Overall approach to updating the Action Plan
    - Revision of the SGCN List
    - Habitat Approach
    - Local Action Plan Summaries
    - Prioritization of Conservation Actions and Focus Areas
    - Stakeholder and Public Input (Element 7 and Element 8)
    - Plan Revision (Element 6)
    - Monitoring (Element 5)
    - Effectiveness measures (Element 5)
- *Statewide Threats, Actions, and Priorities* (Elements 1, 2, 3, 4)
    - Summary information on the SGCN (Element 1)
    - Habitat descriptions and status (Element 2)
    - Statewide threats to species and habitats, including climate change (Element 3)
    - Statewide conservation actions (Element 4)
    - Research needs (Element 3)
- *Local Action Plan Summaries* (Elements 1-5)
    - Overview of planning region
    - Priority SGCN and habitats in the planning region
    - Planning region threats by habitat type
    - Planning region priority conservation actions by habitat type
    - Examples of suitable effectiveness measures
- *Appendices*
    - SGCN List (Elements 1 and 2)

2. Approach and Methods

Virginia's revised Action Plan utilizes a habitat approach to address threats and conservation actions for the state's fish and wildlife resources. This approach helps to ensure that conservation actions benefit a diversity of species within the Commonwealth. A habitat approach also allows for more species to be addressed by any single conservation action and for the more efficient use of limited resources. Additionally, this Action Plan is designed to facilitate implementation at a scale where conservation most often occurs – the local level. The novel approach of including Local Action Plan Summaries provides users the opportunity to "put themselves into the Plan" and understand what specific actions are needed to conserve species and habitats near where they live and work.

Throughout the process, DGIF administrators and the Action Plan's authors worked with the understanding that an effective Action Plan could only be created with input and guidance from DGIF staff, sister agencies, partner organizations, and the public. When creating the first Action Plan, DGIF established multiple teams and panels to build various portions of the Plan. While that process was effective, current circumstances and personnel limitations prevented the use of a similar process in developing a new Action Plan. Instead, the Action Plan's authors compiled draft materials for every aspect of the Action Plan and then reviewed those materials with staff and conservation partners to determine how those materials could be improved and refined. For some issues, this process required several iterations, but it did not require partners and staff to commit the same level of time and energy as the previous model. Draft materials created with partner input were then made available for public review and comment. Specifics of this process are detailed in the following sections.

Species of Greatest Conservation Need List Revision

Congress mandates that each Action Plan identify, "the distribution and abundance of species of wildlife, including low and declining populations as each State fish and wildlife agency deems appropriate that are indicative of the diversity and health of wildlife of the state" (USFWS 2006). These species are commonly referred to as Species of Greatest Conservation Need (SGCN). Within Virginia's original Wildlife Action Plan (2005), DGIF and partners identified 925 SGCN that represented 11 broad taxonomic groups. Because the updated Action Plan's SGCN list is based off the original list developed for the 2005 Wildlife Action Plan, it is important to understand how that list was created prior to describing the changes.

For the 2005 SGCN list, all animal species that use any terrestrial and/or freshwater habitats in the Commonwealth were considered for selection. This potential list included anadromous and catadromous fish, invertebrates, migrants, and all breeding or wintering species. To determine which species would actually be selected as SGCN, a matrix was developed that included all wildlife species in Virginia and their ranks on various lists of conservation concern. Species were divided into major taxonomic groups, and within each taxonomic group all SGCN were assigned a Tier ranking (1 to 4), based on rarity and imperilment.

> *Tier I. Critical Conservation Need.* Faces an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), or occur within an extremely limited range. Intense and immediate management action is needed.

Tier II. Very High Conservation Need. Has a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.

Tier III. High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, or are restricted in range. Management action is needed to stabilize or increase populations.

Tier IV. Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations.

These four tiers became a starting point for review by the Taxonomic Advisory Committees (TACs). These standing committees, arranged by taxonomic group, were maintained by DGIF at the time of the 2005 Action Plan. The TACs were established to provide input on taxonomy, conservation, and other species issues. The TACs included Bird, Fish, Herpetofauna, Mammal, Mussel, and Invertebrate, the last of which included all non-mussel aquatic and terrestrial invertebrates. The final list was reviewed and modified as necessary by the TACs and then submitted to the internal and external steering committees for the 2005 Action Plan for approval as the final SGCN list.

While the original Tier system was sufficient to meet Congressional requirements, it proved to be insufficient to help DGIF and partners set and implement actionable conservation priorities. Threatened and endangered species often require many more resources and time with a smaller chance of recovery within a state than species that are less imperiled (AFWA 2012). To address this issue, the Association of Fish and Wildlife Agencies recommended adopting a triage approach, where costs, benefits, and likelihood of the conservation action being successful are considered together (AFWA 2012). Virginia's updated Action Plan builds upon the Tier ranking process from the original Plan by incorporating a Conservation Opportunity Ranking to document management needs and opportunities for each species.

Conservation Opportunity Ranking

In addition to a Tier ranking (see above), all SGCN are assigned a Conservation Opportunity Ranking (A, B, or C) in the updated Action Plan. These rankings are defined as follows:

- A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.
- B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.
- C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Draft rankings were created based upon the 2005 Action Plan as well as any new information garnered through research and literature review to determine if more recent actions or plans have been developed for each of the SGCN. Draft materials were then provided to biologists and academic researchers knowledgeable of Virginia's species. This process enhances the original Tier system, and the increased number of categories allows the conservation community to better prioritize based upon actions that can be taken to address species' needs.

SGCN Review

In addition to modifying the species prioritization system, DGIF staff also reviewed and updated the SGCN list. To facilitate this review, the authors first reorganized the SGCN based on species type (mammals, birds, etc.) in an Excel spreadsheet. Each spreadsheet entry included: common name, scientific name, the 2005 Tier, and the draft Conservation Opportunity Ranking. The authors also included any relevant actions taken from the 2005 Action Plan, applicable research findings, and research needs identified either within the original Action Plan or from other sources. This effort resulted in a draft SGCN list and prioritization that was used to assist agency and stakeholder review. A comment section also was included for each species.

This Excel spreadsheet was provided to applicable DGIF staff and partners for review. Recipients were encouraged to share these draft materials with anyone they felt appropriate. Recipients of the draft materials were asked to review the species and consider whether the Tier and/or Conservation Opportunity Ranking should be modified based on their knowledge and expertise of the each species' biology and ecology. They were also asked to consider if any species should be removed from the SGCN list or added to the list based upon new information, changing circumstances, or management understanding. All proposed changes were accompanied by a justification based on a template designed by DGIF. Each justification required the following information:

- Complete contact information for the individual or official contact person for the agency or organization submitting the request.
- Common name and scientific name for the species in question.
- One sentence clearly indicating the change that is being proposed (e.g., Add ____ to the list of SGCN as a tier __ species, Remove _____ from the list of SGCN, or adjust the Tier ranking for (species) from Tier __ to Tier __.).
- A (maximum) two-page description indicating why the recommended change is being proposed. This should include reference to the tier/category definitions and justification for change should be in terms of population and/or habitat trends affecting the species in question. Additionally, the justification for a proposed change needs to:
    - Identify issues driving the population and/or habitat trends;
    - Quantify how those trends affect the perceived level of imperilment for that species in Virginia; and
    - Identify conservation actions that can be taken to address the issues impacting the species in question and/or its habitats.
- Relevant citations and copies of executive summaries (maximum of two pages) for peer-reviewed resources.

Once all input was received from DGIF staff and partners, the comments were taken into consideration. The SGCN list was revised based on all partner and public input (See Stakeholder and Public Participation).

HABITAT FOCUS

Throughout Virginia's original Wildlife Action Plan, habitat loss and degradation were identified as the most critical issues hindering SGCN conservation (DGIF 2005). Over the last decade, water quality degradation, habitat fragmentation, and habitat loss have become more acute and widespread. In 2013, DGIF conducted a review of game, fisheries, and diversity programs. This review recognized that a significant amount of game and nongame species are increasingly affected by the loss of, access to, or degradation of their habitats. Responding to these findings, DGIF administrators agreed it was necessary to focus more efforts on habitat conservation and habitat restoration (DGIF 2013). The updated Action Plan works to achieve this goal. By focusing on habitats and the suite of species that depend on each of them, more SGCN will benefit from individual conservation actions. Furthermore, focusing on habitats will enhance opportunities to work with a variety of partners within Virginia's conservation community.

A number of tools developed or identified by DGIF staff and partners have informed the habitat approach designed for the Action Plan. These resources assisted in defining habitats, describing the status of those habitats, as well as identifying threats and conservation priorities for habitats within the Action Plan. The primary materials include:

Northeast Terrestrial and Aquatic Habitat Maps and the Habitat Classification Guide (Anderson et al. 2013) – This classification system was designed by staff of The Nature Conservancy (TNC) and provides a map of aquatic and terrestrial ecological systems for the 13 states represented by the Northeastern Association of Fish and Wildlife Agencies. This system is hierarchical and identifies 121 ecological systems within the Northeast region which are organized into 35 macrogroups (Anderson et al. 2013). A significant portion of the Action Plan update involved reviewing TNC's data and compiling that information in ways that facilitate land management and habitat conservation. In addition to distribution, TNC's data describes how much of each habitat has been conserved by acquisition or easement, patch size, age class distribution, predicted loss due to development, and degree of connectedness among the individual habitat patches. This mapping system and its corresponding classification guide were used to develop regional habitat maps for the Local Action Plan Summaries (described below) and to help define the habitat groups used within this Action Plan. The 61 ecological systems present in Virginia were reorganized into approximately 8 habitat groups (e.g., wetland, mixed hardwood/ conifer forest, open habitat, etc.) that align with the Commonwealth's resource management efforts.

Virginia Water Quality Improvement Plans (DEQ 2014) – Virginia's Department of Environmental Quality (DEQ) monitors water quality throughout the Commonwealth. When water quality problems are identified, watersheds are designated as impaired based upon the load of a variety of physical and chemical factors (e.g., nitrogen, phosphorus, fecal coliform, etc.). Many of the impaired watersheds require a metric known as a Total Maximum Daily Load (TMDL). A TMDL designates a maximum acceptable load of the chemical and physical inputs that a watershed can accommodate without posing a risk to human health or other resources. When a TMDL has been established for a watershed, DEQ staff, in collaboration with communities, partners, and private individuals, work to create a Water Quality Improvement Plan that identifies the types of impairments impacting a watershed, the sources of those impairments, and what actions can be taken to address those impairments. Many of the water

quality issues discussed within the TMDL designations and subsequent plans are consistent with threats and conservation actions identified within Virginia's first Wildlife Action Plan and modern discussions with conservation partners. Commonly prescribed conservation actions in the Water Quality Improvement Plans include restoring riparian buffers, working to exclude cattle from streams, reducing nutrient-laden runoff, revegetating upland sites, and reducing erosion. In addition to improving water quality, these actions also benefit a great diversity of aquatic and terrestrial SGCN. Absent other priorities, the updated Wildlife Action Plan treats watersheds with Water Quality Improvement Plans as priority areas for aquatic and riparian habitat restoration efforts.

Virginia Watershed Integrity Model (Ciminelli and Scrivani 2007) – In 2007, the Virginia Department of Conservation and Recreation's Division of Natural Heritage, the Virginia Department of Forestry, the Virginia Commonwealth University Center for Environmental Studies, and the Virginia Coastal Zone Management Program developed the *Virginia Watershed Integrity Model* to identify land-based areas that should be conserved to help improve or maintain water quality. Water quality is greatly influenced by adjacent land use, and this model's inputs focus on terrestrial factors that influence water resources and watershed integrity. These inputs include information related to headwater streams, drinking water sources, ecological core information, stream/ river/ floodplain data, and indices of biological integrity. The model compiles this information to rank watersheds across the state in terms of their integrity value. The model outputs are meant to help target conservation efforts, prioritize or provide justification for acquisition and protection, assist with local planning, help with project assessments, be used by land managers, and provide an education resource. The watershed integrity model is used within this Action Plan to identify high quality watersheds that may be conservation priorities within individual planning regions. It is important to note that this model is currently being updated, and new material should be available during 2016. The maps found within this Action Plan were created from the 2007 data. As new maps become available, they will be included in the Action Plan's online version.

Virginia Wetlands Catalog (Weber and Bulluck 2014) – In 2014, staff with Virginia Department of Conservation and Recreation's Natural Heritage Program completed an inventory of wetlands and potential wetlands within the Commonwealth. This inventory is known as the Virginia Wetlands Catalog and was developed to identify and prioritize wetlands based upon their habitat value and ecological function. These data are used to identify high quality wetlands that are considered a priority for conservation as well as degraded wetlands that could be improved or restored with conservation actions. The conservation and restoration priorities identified in this catalog informed development of wetland specific conservation priorities in the Local Action Plan Summaries.

SGCN Watershed Distribution Maps – Within Virginia's original Action Plan, authors provided distribution maps for the most critically imperiled SGCN. These maps include buffered point locations where individual animals had been documented as well as areas designated as potential habitat. While these maps were informative, they were limited in their ability to inform multi-species conservation actions. In 2009, DGIF staff developed new distribution maps for each SGCN identified within the original Action Plan whose distribution was known. These new maps were based on fine scale watersheds referred to as HUC12 watersheds (Weary and Doctor 2014). Virginia's HUC12 watersheds range in size from approximately 15 square miles to 70 square miles. Each of Virginia's counties typically encompasses 10 to 15 HUC12 watersheds. HUC12 maps were created for approximately 500 of the original 925 SGCN. The majority of these were vertebrates, freshwater mollusks, and crayfish. By mapping SGCN distributions within HUC12 watersheds, the updated Action Plan is able to identify areas that support multiple SGCN (Figure 2.1). Likewise, HUC12 maps are at a fine enough scale to identify priority areas within a county or planning region, but at the same time are coarse enough to hinder

illegal collections or be perceived as a threat to private landowners. SGCN distribution maps are provided in each Local Action Plan Summary.

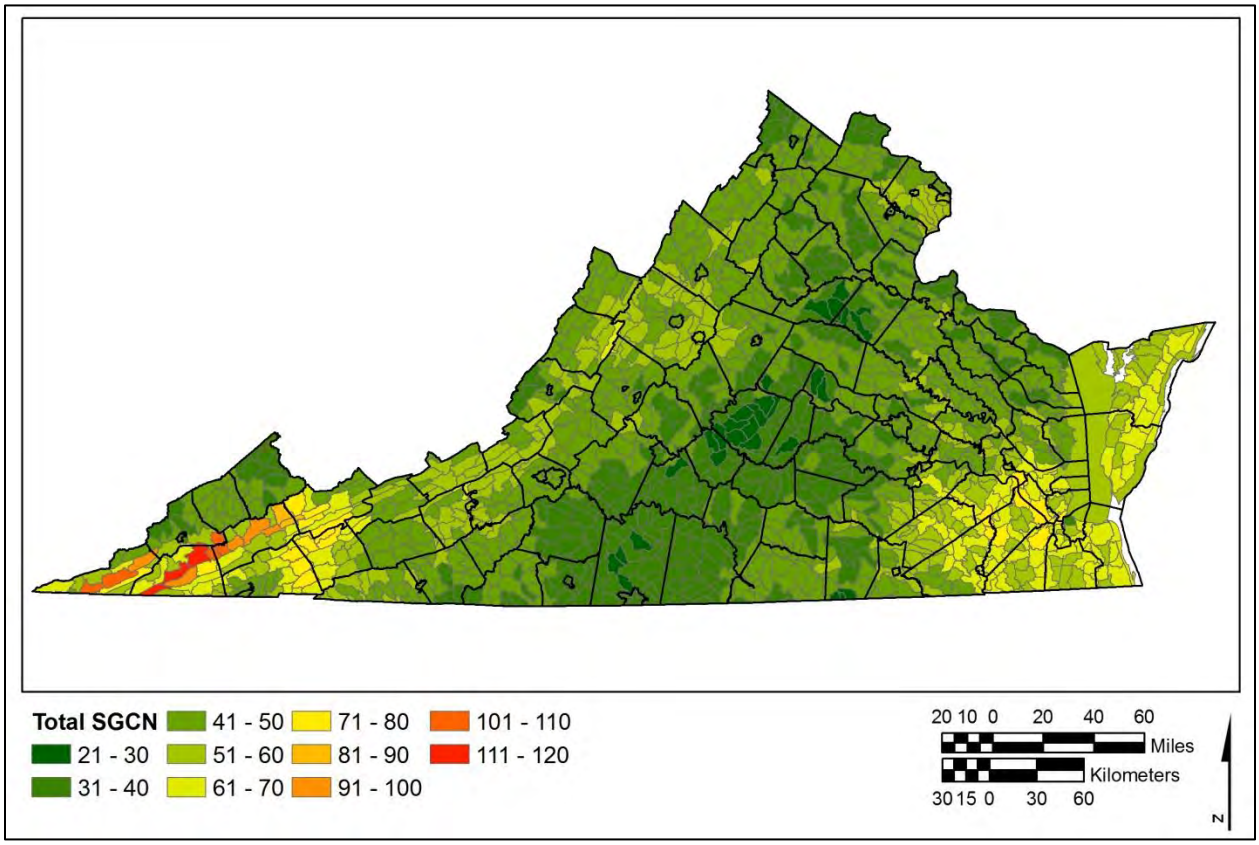

Figure 2.1. SGCN Density by HUC12 Watersheds.

Northern Bobwhite Quail Action Plan for Virginia (DGIF 2007) – In 2007, responding to a dramatic loss of open habitats and the subsequent declines in northern bobwhite quail and other open habitat species, DGIF staff and partners completed Virginia's first Quail Action Plan (DGIF 2007). This document identifies six focus areas where habitat restoration efforts are focused. Although quail are a primary focus, it has always been DGIF's assertion that providing habitats suitable for quail will also benefit scores of SGCN that utilize glade, grassland, savanna, and shrubland habitats. Absent other priorities, efforts to conserve and restore open habitats within the Action Plan will focus on these six priority areas.

Management-Based Habitat Categories

Habitats are often described by managers at the scale in which they work. To determine the habitat categories appropriate for the Action Plan, the authors first reviewed available literature and developed a brief description of each SGCN's habitat requirements. This process relied upon data from the Virginia Fish and Wildlife Information System (http://vafwis.org/fwis/), the Audubon Society's Online Guide to North American Birds (http://www.audubon.org/field-guide/bird/), Freshwater Fishes of Virginia (Jenkins and Burkhead 1993), and the NatureServe Explorer (http://explorer.natureserve.org/). Using this information, the authors drafted a list of potentially important SGCN habitat types within the state. The authors organized a series of meetings with DGIF staff from across the state to review the draft materials and discuss how they could be improved. The authors also met with key conservation partners to further refine the habitat list. Priority habitats discussed during these meetings included:

- Marine habitats
- Dunes, Beaches, and Mudflats
- Tidal wetlands
- Non-tidal wetlands
- Freshwater aquatic and riparian habitats
    - Tidally influenced warm water streams and rivers
    - Coldwater streams and rivers
    - Non-tidal warm water streams and rivers
    - Blackwater streams and rivers
- Open habitats
- Piedmont and coastal mixed hardwood/ conifer forests
- Western mixed hardwood/ conifer forests
- High elevation forests (spruce and other high elevation)
- Karst and subterranean habitats
- Other fine-scale microhabitats

During each of the habitat meetings, participants were asked to help identify threats impacting each of these habitats, describe actions that could be taken to address those threats, and identify any priority areas or micro-habitats that should be specifically identified within the updated action plan. Descriptions of each habitat type are provided within the Statewide Section. The Northeast Terrestrial Habitat Map was used to map the primary habitat types for each Local Planning Region Summary.

LOCAL ACTION PLAN SUMMARIES

Since Virginia's original Action Plan was completed, a number of DGIF staff and partners expressed concerns regarding its format. Many found the Action Plan difficult to use and, thus, were unable to identify local priorities and develop "on the ground" projects to address conservation needs. DGIF recognized this issue and has worked to address it by incorporating Local Action Plan Summaries (Local Summaries) into this version of the Action Plan.

Each of these Local Summaries will provide localities with information regarding priority SGCN, the habitats those species require, threats impacting species and/or habitats, and actions that can be taken to address those threats. Whenever possible, each Local Summary will indicate which areas have been identified as being a priority either for conservation or for restoration efforts.

To achieve this goal, DGIF adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan (DCR 2013). The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions (Figure 2.2). Each Recreational Planning Region is roughly analogous to one of Virginia's 21 Planning District Commissions (PDC).[1] The PDCs are voluntary associations of local governments established to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues.

[1] More information on Planning District Commissions can be found at: (Virginia Association of Planning District Commissions, http://www.vapdc.org/?page=About).

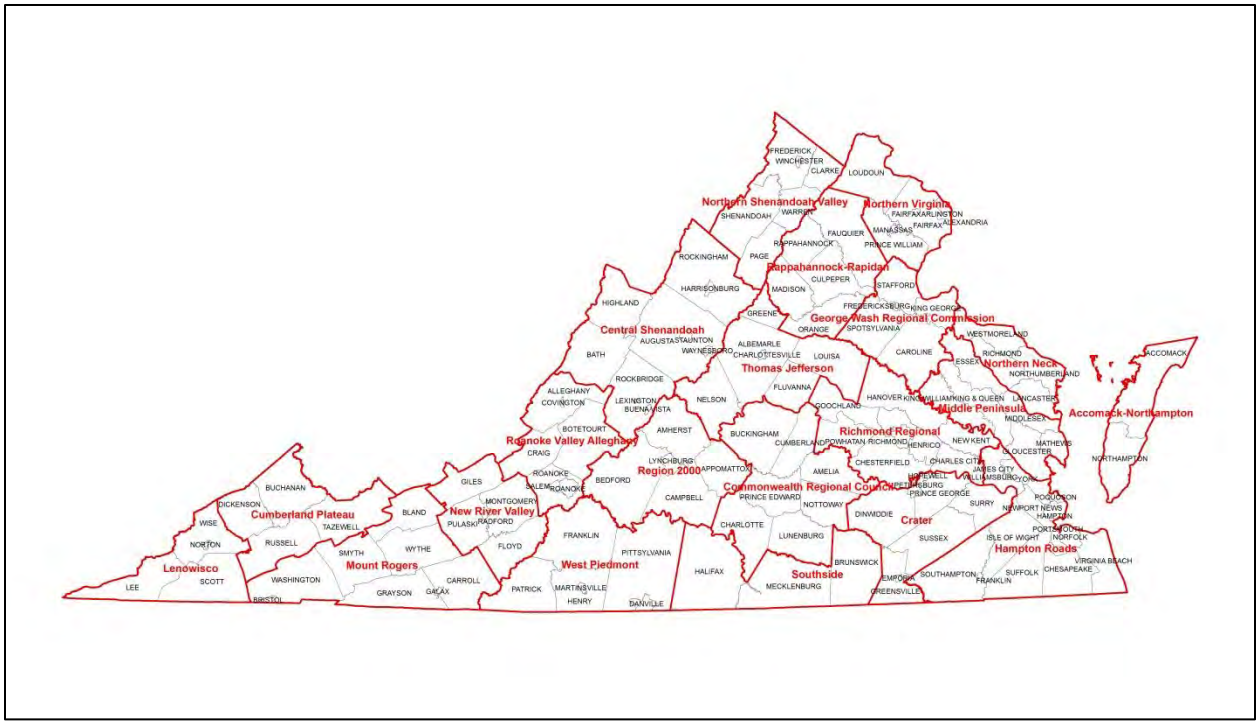

Figure 2.2. Local Planning Regions.

With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. By using DCR's model to identify and address local wildlife and habitat issues, it is anticipated that the updated Action Plan will complement and enhance an existing planning infrastructure, better identify local priorities and multi-species conservation opportunities, and facilitate "on the ground" conservation actions that benefit local communities and their local wildlife resources.

Local Summary Development

The Local Summaries were developed through a multi-year iterative process, involving DGIF staff and the Conservation Management Institute (CMI) at Virginia Tech. The need for a scaled-down, locally relevant summary of Action Plan information was first articulated in 2009 within *Virginia's Strategy for Safeguarding Species of Greatest Conservation Need from the Effects of Climate Change* (a companion document to the original Action Plan that identified 10 initial climate change adaptation strategies) (DGIF et al. 2009). Summaries were identified as an important resource needed to identify local conservation issues and support implementation of local conservation efforts.

Local Summaries use information from the original Action Plan, new species distribution maps, and other input gathered through modeling, research, and meetings with both DGIF staff and partners. Specific data included in each Local Summary are described below. DGIF staff and partners were also given the opportunity to review and provide input on the early draft versions of the Local Summaries, during the Action Plan update process. The Local Summaries were revised based upon this review. Revised Local Summaries were a part of full Wildlife Action Plan draft that was provided to conservation partners and the public for review in spring of 2015. All comments and revisions were considered for inclusion.

Priority SGCN within the Local Summaries

The Local Summaries focus attention on those SGCN for which the individual planning region comprises a significant portion of the Virginia range. First, SGCN distribution maps (see Habitat Approach) were used to identify which SGCN occur within each of the 21 planning regions by HUC12 watersheds. The entire SGCN list for each planning region is included as Appendix A within each Local Summary. In some cases, hundreds of species were identified as occurring within an individual planning region. Upon reviewing the local SGCN lists and conferring with partners, it was determined that the initial local SGCN lists were too long to provide a meaningful prioritization, because these lists included numerous species that were on the fringe of their range. As such, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. This modification reduced the size of many SGCN lists by half or more and allows local conservationists to focus efforts on those species for which they can make the greatest impact.

It should be noted that the 10 percent rule is arbitrary. In discussions, DGIF staff and partners recommended using values ranging from 2 percent to 40 percent. A literature review and follow-up discussions failed to provide any significant guidance as to what value would be most appropriate. Lacking additional input or peer-reviewed justification, DGIF's Wildlife Action Plan Coordinator selected 10 percent as it produced manageable SGCN lists and was acceptable to the majority of staff and partners.

While updating the Action Plan, the 10 percent rule was modified, in specific instances, to address several issues. First, some SGCN occur statewide but in low numbers in each planning region. As such they will never reach the 10 percent threshold in any single planning region. When these incidents were identified, the Action Plan authors worked with DGIF staff and others to determine which planning regions were most appropriate, and the species was manually added to those local lists of priority species. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists due to their rarity in the state and the importance of those few planning regions to its survival. In several instances, significant properties have been conserved to provide habitats for migratory species. While an individual species may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists. Finally, partners identified instances where a species may have a particularly strong population in a relatively small portion of a planning region. While the species might not reach the 10 percent rule for that planning region, the specific populations in question were determined to be significant enough to warrant inclusion on the local priority SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

For each priority SGCN, Tier and Conservation Opportunity Ranking and primary habitat descriptions are included within each Local Summary. Maps depicting the highest density of SGCN throughout each planning region are also included in an effort to help understand where the most species would be conserved or would benefit from conservation action.

Priority Threats and Conservation Actions within the Local Summaries

Threats and conservation actions are described at a habitat level within each Local Summary. To develop these sections, the authors first referred to the original Action Plan, reviewing the threats and actions outlined for the Tier I SGCN and the overall threats and actions described in the 2005 Action Plan's appendices. The greatest threats to the majority of species involve the loss or degradation of habitats. Common causes include fragmentation, nonpoint source pollution, and land development. The authors summarized this information and used it as a baseline for discussions with DGIF staff and partners at meetings to discuss priority habitats (see above). The outcome of these meetings indicated that Virginia's Action Plan could be revised with a greater habitat focus and that implementing habitat conservation and restoration activities could be a viable means of conserving multiple SGCN simultaneously.

The habitat-based meetings were held across Virginia. DGIF staff members who have experience with a particular habitat were invited to each relevant meeting. Many DGIF staff attended multiple meetings. The meetings were structured to elicit feedback from staff on how to divide and describe habitats as well as review the initial list of threats and actions to the habitats. The goal of these meetings was to gain a better understanding of how managers within the state categorize habitats, what they see as threats to habitats, and the conservation actions that could address those threats. The last part of these meetings was focused on working to identify priority areas for conservation actions. The Action Plan authors held 12 meetings with DGIF staff to discuss aquatic and terrestrial habitats. Another 10 meetings were held with conservation partners to discuss specific habitat types and conservation areas. These meetings included discussions with staff from the National Wildlife Refuges in Virginia, USFWS Virginia Offices in Gloucester and Abingdon, the Virginia Department of Forestry (DOF), the U.S. Forest Service (USFS), the Natural Resources Conservation Service (NRCS), The Nature Conservancy (TNC), the Xerces Society, and DCR Natural Heritage program. Meetings with other organizations were requested but could not be arranged (see Stakeholder and Public Participation). Finally, additional threats, actions, and priorities were identified during the Action Plan review process.

Within the Local Summaries, priority habitat types present within the planning region were determined from the local SGCN list (see above). As each SGCN entry includes a basic description of habitat needs, species can be grouped into basic habitat-oriented categories (e.g., wetlands, riparian, open habitats, karst, etc.). Each Local Summary includes a brief narrative that identifies the primary threats impacting each priority habitat within each planning region. Threats were identified from the habitat meeting notes and resources provided by meeting participants. Local Summaries also describe priority conservation actions that can be taken to address the identified threats. These conservation actions were also developed based on habitat meeting notes as well as resources provided by meeting participants, partners, and other resources.

CLIMATE CHANGE

Climate change is a stressor that will exacerbate most other existing threats and affect management actions over the long-term (Klopfer et al. 2012; Kane et al. 2013). The original Action Plan indicates climate change threatens several SGCN; however, the issue is not extensively addressed. In an effort to consider climate change impacts on wildlife and habitats within the state, DGIF began working with the National Wildlife Federation and Virginia Conservation Network in 2008. Together, they planned two

workshops to bring together key partners within Virginia to discuss climate change and conservation. Over 35 groups and agencies participated in this process to create *Virginia's Strategy for Safeguarding Wildlife from Climate Change* (DGIF et al. 2009). The 2009 climate change strategy identified 10 specific recommendations ranging from habitat conservation to research to outreach.

A key research recommendation called for more Virginia-specific climate change information and details about how climate change is likely to impact Virginia's species and habitats. Based on this recommendation, DGIF worked with CMI and the National Wildlife Federation to develop new climate models and conduct a species vulnerability assessment. This project was designed to create spatially explicit climate forecasts, determine the magnitude and occurrence of future climate changes within the Commonwealth, and describe the impacts that those climate changes may have on the distributions of a selection of SGCN and their habitats. Once the climate data were generated and vulnerability assessment was complete, the data were used to go a step further and consider landscapes and habitat conservation more broadly. This effort culminated in the Virginia Conservation Lands and Climate Assessment.

Conservation Lands and Climate Assessment

Habitat loss and habitat degradation are the greatest threats impacting the Commonwealth's SGCN. To help address these threats, Virginia's conservation community has made significant investments to conserve lands that can be managed to provide SGCN with habitats. Unfortunately, recent climate change research and related species vulnerability assessments (Klopfer et al. 2012; Kane et al. 2013) indicate habitat-related issues could become more acute as climatic conditions change. In addition, landscapes will likely be subjected to changing land use patterns driven by the need for ecosystem goods, increased agricultural production, and expanding human development (Klopfer and McGuckin 2015).

During the last century, state and federal agencies, as well as NGO partners, have made significant investments to acquire lands and create wildlife management areas, parks, refuges, and easements to conserve important habitats, provide recreational opportunities, and conserve priority species, including SGCN. These parcels, in aggregate, comprise a "conservation lands portfolio" and provide the backbone for SGCN management strategies in Virginia. Previous studies have indicated many of the nation's priority species are vulnerable to climate change, and that climate change could have profound impacts on conserved lands and the habitats they provide throwing the long-term viability of this portfolio, and conservation strategies dependent on them, into question (Klopfer and McGuckin 2015).

In order to better understand these issues and how land management efforts might be adapted to address these changing circumstances, DGIF partnered with Virginia Tech's Conservation Management Institute (CMI) to implement the Conservation Lands and Climate Assessment project (Klopfer and McGuckin 2015). Per this effort, CMI compiled and analyzed existing data regarding conserved lands, current climatic conditions, and projected future climatic conditions to assess how climatic conditions are expected to change across Virginia and what impacts those changes could have on the conservation lands portfolio/ network (or CLN).

Existing information from the Virginia Conservation Lands Database (VCLNA) was combined with climate data provided by the WorldClim climate data portal (http://www.worldclim.org/)and the CMIP5 (Coupled Model Intercomparison Project Phase 5 (CMIP5) global climate model used in the 5th International Panel on Climate Change. These datasets provide modeled climate scenarios at multiple

spatial scales and time periods (Hijmans et al. 2005). This project also used the "bioclimatic" set of information for both the current and modeled climate data. This set contains 19 variables that have been used in assessing climate impacts on biodiversity designed to asses annual and seasonal climate factors as well as extremes (Hijmans et al. 2005). This analysis used both the annual mean temperature (BIO1) and annual mean precipitation (BIO12) for the study area. The final analysis compares data from 2000 (current) and predictions for the year 2070 (Klopfer and McGuckin 2015). Temperature and precipitation data for 2000 were combined to create a potential 81-class map covering the majority of the Eastern U.S.; although, only a fraction of these climate classes occur in Virginia. This same process was applied to the temperature and precipitation data for the 2070 climate layer.

This assessment is used to highlight how conditions may change within Virginia and projected representation of conservation lands within each climate class in the future so that managers may understand the types of habitats and species that may or may not be resilient and/ or vulnerable as conditions change on existing conservation lands in Virginia. Each parcel of conserved land was evaluated to determine if climatic conditions related to temperature and precipitation are expected to change and how significant those changes are expected to be. This process allowed researchers to summarize the total area of each climate class that was protected by the CLN or not. It also allowed for a comparison of the total composition and change between climate classes at each time period to determine which climate classes would likely be lost, gained, or remain the same within the CLN in 2070. All of these analyses were completed using Microsoft Excel from tables that were exported from the GIS (Klopfer and McGuckin 2015).

This project attempts to illustrate how climate change information can be used to assess climate-related changes on the landscape and related impacts to natural resources. This will likely yield the greatest information when applied under a specific set of circumstances for a particular purpose. Our results are general, but can be easily applied to more specific information needs. This type of information may be useful in informing species-specific climate mitigation adaptation planning. While this analysis has provided some information on where suitable climate conditions may exist in the future, it did not attempt to determine whether species could be expected to shift along with the climate class. Species movement across the landscape is highly dependent on localized factors, so while suitable conditions may be found elsewhere in the study area there is no guarantee that species will be able to access it. Therefore, this information could be an integral part of conservation planning to determine what sorts of targeted management actions would be necessary to establish species populations. Techniques such as assisted migration, corridor design, vegetation management, or other efforts can be considered using the information provided with this technique.

This Action Plan also uses climate change data in two other capacities. First, climate change information is presented within the Statewide Threats Section. This material outlines projected impacts across Virginia and how these changes may impact SGCN and habitats. Climate change is also integrated into each Local Summary. For each priority habitat, the Local Summary includes any relevant climate change-related threats and provides a description of "climate-smart" actions that can be taken to help ensure the benefits of conservation actions in the face of changing climatic conditions.

MONITORING, EFFECTIVENESS MEASURES, AND RESEARCH NEEDS

Monitoring

In terms of monitoring, an Action Plan must describe how each state will monitor the status of species and habitats that have been included within the Action Plan. Information on monitoring within the Action Plan must also identify the mechanisms that will be used to monitor the effectiveness of conservation actions implemented on behalf of the Action Plan. Finally, each Action Plan must describe the mechanisms that will be used to adapt conservation actions in response to new information or changing conditions. While distinct, these concepts are related. Ideally, over time, conservation actions that are implemented will produce detectable improvements for local wildlife populations and/ or their habitats. While the benefits of some projects might not be fully realized for years or even decades, monitoring the changes achieved from conservation efforts will make it possible to evaluate the conservation community's ability to achieve conservation goals. Additionally, information from monitoring will allow managers to adapt those efforts to be more effective as experience is gained and changes are observed. DGIF staff and partners used the following mechanisms to address monitoring within Virginia's second Action Plan.

Monitoring Species Status

Virginia is home to over 30,000 species. These include vertebrates, invertebrates, aquatic, terrestrial, marine, karst, and migratory species. With available resources, it is impossible to maintain an accurate census of this many populations. As an alternative, DGIF staff work with multiple partners to collect species data that are incorporated into data systems and the Action Plan. These efforts include:

Population Monitoring by DGIF Staff – DGIF field staff spend many months each year collecting data on wildlife populations. DGIF staff may also hire academic institutions or private entities to collect species data on the agency's behalf. In many cases, data collection efforts are iterative multi-year projects. Much of the data collected are incorporated into the Virginia Fish and Wildlife Information System – a publicly available database that allows access to data and information about Virginia's wildlife. Among other uses, these data inform species management efforts and the environmental review process. These data, in conjunction with other information, were used to determine if a species should be included within Virginia's Wildlife Action Plan and how a species should be prioritized within the Tier structure (see Methods – Species of Greatest Conservation Need List Revision). Results of individual data collection and species monitoring efforts are reported in annual reports for State Wildlife Grants and Wildlife Restoration Grants provided to the USFWS. Examples of recent monitoring efforts funded with State Wildlife Grants and other resources include the blackbanded sunfish in southeast Virginia, freshwater mussel populations in Copper Creek and other portions of the Clinch River, the Atlantic sturgeon in the Chesapeake Bay watershed, and beach nesting species on Virginia's beaches and barrier islands.

Scientific Collection Permits –DGIF is responsible for regulating the collection of wildlife-related data by researchers and partner organizations within the Commonwealth. The permitting process requires that species distribution data collected during projects performed by permitted individuals be submitted to DGIF annually. These data are reviewed for accuracy and then incorporated into the Virginia Fish and Wildlife Information System – a publicly available database. These data are also used to determine if

species should be included within Virginia's Wildlife Action Plan and how a species should be prioritized within the Tier structure (see Methods – Species of Greatest Conservation Need List Revision).

NatureServe Status Rankings – NatureServe is an international nonprofit organization that works to answer four questions: What species and habitats exist? Where are they found? How are they doing? And which are conservation priorities? NatureServe provides a standardized set of global status rankings for species and habitats. These are commonly referred to as the "G&S" ranks. "G" represents "global" status, and "S" represents "state" status. Both the global and the state rankings utilize a 5-point ranking criteria. A score of 5 indicates a species is "Secure", a score of 4 indicates a species is "Apparently Secure", a score of 3 indicates a species is "Vulnerable", a score of 2 indicates a species is "Imperiled", and a score of 1 indicates a species is "Critically Imperiled." The state ranking might also include SH, which indicates a species is "Possibly Extirpated," or a value of SX indicates a species is "Presumed Extirpated" in Virginia. The S ranks are maintained by the DCR Natural Heritage Program, a member of the NatureServe Network. NatureServe rankings are generally consistent with the Action Plan's Tier system.

Monitoring Habitat Status

Water Quality

The National Clean Water Act requires each state to monitor the quality of its surface and ground waters to determine if they support six designated uses, including aquatic life, fish consumption, public water supplies (where applicable), recreation (swimming), shellfishing, and wildlife (DEQ 2014). Virginia also has instituted subcategories under most of these designated use categories. The U.S. Environmental Protection Agency (USEPA) requires that DEQ prepare biennial reports (305(b)/303(d) Water Quality Integrated Report), describing the status of water quality within the state (DEQ 2014). During the course of their water quality monitoring to prepare these reports, DEQ personnel gather data from 4,328 stations located in Virginia's lakes, reservoirs, rivers, and estuaries. The types of data collected include measurements of temperature, pH, dissolved oxygen, nutrients, suspended solids, bacteria, metals, pesticides, herbicides, and toxic organic compounds. These data allow individual waters to be classified into one of five groups:

- Category 1: Water that fully supports all designated uses.
- Category 2: Water that fully supports some designated uses, but there is either insufficient or no information regarding the remaining designated uses.
- Category 3: There is insufficient information to determine if designated uses are being met.
- Category 4: Waters are impaired or threatened but do not need a TMDL.
- Category 5: Waters are impaired and need a TMDL.

The Water Quality Integrated Report is transmitted to Congress and the USEPA. Based on water quality monitoring and the degree of impairment, a watershed may require a Total Maximum Daily Load (TMDL) figure be calculated (see Statewide Overview; Freshwater Aquatic and Riparian Habitats). The most seriously impaired waters require a Water Quality Improvement Plan (see Statewide Overview; Freshwater Aquatic and Riparian Habitats). Virginia's list of impaired waters and the available water quality improvement plans are available online (DEQ 2014).

Virginia's Healthy Waters Initiative

Virginia's Healthy Waters Initiative, a joint effort of the DCR, Virginia Commonwealth University, and DEQ, is an effort to broaden conservation efforts to maintain critical, healthy resources before they are compromised. This Initiative is meant to work in concert with water quality programs that focus on repairing degraded systems to protect living resources. The approach encompasses protecting everything from aquatic insect larvae and bugs hidden in gravelly stream bottoms to forested buffers alongside streams to natural stream flows to the water we drink in an effort to maintain ecological balance. Healthy streams in Virginia have been identified and ranked through a stream ecological integrity assessment known as the Interactive Stream Assessment Resource (INSTAR). Streams may be ranked as "exceptionally healthy," "healthy," or "restoration candidate." Developed by the Center for Environmental Studies at Virginia Commonwealth University, INSTAR is an online interactive database application that identifies healthy streams using stream data that includes information about fish communities and insects, in-stream habitat, and riparian borders. Healthy waters are incorporated into DCR's Natural Heritage Biotics Database and used for land conservation and land planning purposes.

Virginia Wetlands Catalog

The Virginia Department of Conservation and Recreation/Natural Heritage Program, working with the Natural Resources Conservation Service, the Virginia Department of Transportation, The Nature Conservancy, and Virginia Commonwealth University's Center for Environmental Studies, has developed the Virginia Wetlands Catalog. This tool considers the condition and status of wetlands and ranks them in terms of restoration or conservation priority. Wetland patches are evaluated on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources, proximity to degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Weber and Bulluck 2014). This material provides the most extensive set of habitat quality data available for Virginia's wetlands, and it is used to identify priority areas for wetlands conservation and wetlands restoration within each of the Local Summaries.

Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool

Many of Virginia's rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. In recent years, two tools have been developed to explore this issue. The Chesapeake Bay Fish Passage Prioritization Tool was designed by The Nature Conservancy in coordination with the NOAA Restoration Center, the U.S. Fish and Wildlife Service's Maryland Fisheries Resource Office, and other partners (Martin and Apse 2013). The Southeast Aquatic Connectivity Assessment Tool was designed by The Nature Conservancy in coordination with the Southeast Aquatic Resource Partnership, the South Atlantic Landscape Conservation Cooperative, and other partners (Martin et al. 2014).

Both tools were created to evaluate the ecological return on investment of restoring connectivity in streams and rivers. Dams were assessed in terms of their ability to provide ecological benefits for one or more species if removed or altered to allow fish to bypass. Contributors to these tools prioritized dams for removal throughout the study areas based on benefits to three target groups of species – diadromous fish, resident fish, and brook trout. A wide range of metrics were developed and assessed for each of the three targets to help identify which dams were of highest priority for each of the three targets. Metrics for diadromous fish included amount of upstream river length available; upstream and downstream barriers, amount of impervious surface, amount of natural landcover, stream health, and number of diadromous species in the stream network, etc. The prioritization tool for diadromous fish was used to identify the top 3 tiers (top 15%) of priority dams for removal or alteration within Virginia. Most of these dams fall within the Coastal Plain region. Within this Action Plan, where a planning region contains high priority dams for removal or modification, these priorities are identified within its Local Summary, and a map is included to indicate which watersheds would benefit from enhanced connectivity.

Forest Inventory and Analysis

The National Forest Inventory and Analysis effort uses remote sensing data and field data from permanent, confidential plots to determine change in forest cover and productivity (timber volume) nationwide. There are 4,691 permanent plots in Virginia (Rose 2011). Each plot is surveyed once every five years, so that all plots are covered over a five-year survey cycle. Data recorded at each plot include forest type, ownership, tree volume, individual tree species, age, diameter, height, condition, and presence of invasive species. Because this survey effort began in 1940, many changes in methodology have occurred since its inception. These changes make it difficult to draw small-scale (i.e., local) conclusions about trends from these data. However, trends involving multiple planning regions, as well as statewide and national trends, are available.

Northeast Terrestrial Habitat Map

In 2013, The Nature Conservancy, working on behalf of the Northeast Association of Fish and Wildlife Agencies and the North Atlantic Landscape Conservation Cooperative completed *Northeast Habitat Guides: A Companion to the Terrestrial and Aquatic Habitat Maps* (Anderson et al. 2013). This document and the habitat classification system it describes were developed "…as a comprehensive and standardized representation of habitats for wildlife that would be consistent across states and consistent with other regional classification and mapping efforts" (Anderson et al. 2013). As part of each habitat's description, the authors indicate in which states the habitat occurs, how many acres occur within each state, and how many of those habitat acres are managed as some form of conserved land. This report also provides tables indicating patch size, age class distribution, likelihood of loss due to development, and degree of fragmentation. These data provide a snapshot of status for habitats restricted to Virginia, and provide a general overview of status information for habitats that occur more broadly across the Northeast. The status information provided within the Terrestrial habitat map report is supplemented by additional information provided within *Conservation Status of Fish, Wildlife, and Natural Habitats in the Northeast Landscape: Implementation of the Northeast Monitoring Framework* (Anderson et al. 2011).

Natural Communities of Virginia: Classification of Ecological Community Groups

DCR's Natural Communities of Virginia: Classification of Ecological Community Groups is a classification system that represents assemblages of co-existing, interacting species, considered together with the physical environment and associated ecological processes that usually recurs on the landscape. DCR's natural community inventory and classification represent an important "coarse-filter" approach to biological conservation that ensures the protection of intact ecological systems containing diverse organisms. By identifying and protecting excellent examples of all natural community types in Virginia, the majority of our native plant and animal species, including many cryptic and poorly known ones, can be protected without redundant individual attention (Fleming et al. 2013). More information and detailed classification descriptions and images can be found online at http://www.dcr.virginia.gov/natural_heritage/natural_communities/nctoc.shtml.

Measuring the Effectiveness of Conservation Actions

Since Virginia's original Action Plan was completed, monitoring and reporting the effectiveness of conservation actions has become an increasingly important issue. In late 2005, the U.S. House of Representatives initiated a performance review of the USFWS's Wildlife and Sportfish Restoration Programs, including State Wildlife Grants. This report concluded that results, related to the effectiveness of conservation actions, "are not being demonstrated". In subsequent years, funding for State Wildlife Grants has been scrutinized regarding its value to the American public. The USFWS and state wildlife agencies have worked to develop a mechanism to describe the importance and value of this program and the Wildlife Action Plans. In September of 2009, the Association of Fish and Wildlife Agencies (AFWA) recruited staff from a diversity of state wildlife agencies and nongovernmental organizations to develop and test a framework of effectiveness measures to support the State Wildlife Grants program and the implementation of Action Plans. This framework of effectiveness measures was designed to:

- *Provide a means to evaluate conservation actions so that successful activities/programs can be continued and communicated and less successful ones improved or abandoned;*
- *Establish a standardized and accessible body of project performance data to inform and guide actions by current and future wildlife managers; and*
- *Provide a cost-effective mechanism for reporting data through regional and national summaries that will help meet congressional reporting expectations and articulate the value of state wildlife grants, and potentially the wildlife action plans, to policy makers, conservation partners, and taxpayers (AFWA 2011).*

The final Effectiveness Measures report identifies 11 basic conservation actions that have been implemented by states to support their Wildlife Action Plans (AFWA 2011). These include:

- Direct Management of Natural Resources;
- Species Restoration;
- Creation of New Habitat;
- Acquisition/Easement/Lease of Land;
- Conservation Area Designation;
- Environmental Review;
- Management Planning;

- Land Use Planning;
- Training and Technical Assistance; and
- Data Collection and Analysis.

For each project type, the working group used a planning tool called a Results Chain to identify intermediate output measures that can be used to evaluate the quantity and quality of work completed during a project's implementation (FOS 2007). Each results chain also identified longer-term outcome measures that are used to evaluate how successful a project is in meeting its intended goals.

This working group's final report was completed and approved by the AFWA Executive Committee in April 2011. Subsequently, the USFWS's branch of Wildlife and Sport Fish Restoration (WSFR) adopted this framework and coordinated with AFWA and state agency partners to incorporate these measures into the Tracking and Reporting on Actions for Conservation of Species (Wildlife TRACS) reporting system. Once fully operational and implemented, Wildlife TRACS will serve as the mandatory, central repository for all projects implemented using State Wildlife Grant and other WSFR grant programs. As the Wildlife TRACS framework was developed to specifically support Action Plan implementation, and has been integrated into the mandatory project reporting system, DGIF will use these resources to track the effectiveness of conservation actions in the Action Plan as outlined by Congress.

In addition to facilitating DGIF's prioritization and use of State Wildlife Grants and other resources, the Action Plan was also created to serve the broader conservation community and facilitate their actions. These efforts often occur without utilizing federal funds or involving DGIF which presents a vexing challenge. While efforts supported by DGIF can be tracked and evaluated using the resources described above, efforts implemented without DGIF involvement are not always reported or considered when the success of the Action Plan's implementation is being reviewed. This makes it more difficult to monitor the effectiveness of conservation actions and monitor resource changes over time.

Several issues hinder the effectiveness reporting on these non-DGIF projects. First, the issue of effectiveness was not comprehensively addressed within Virginia's original Action Plan. Many partners were not informed that effectiveness reporting was an important factor to consider nor were they provided with insights about the types of data that would be most useful to collect. Second, many partners face budget limitations and personnel shortages. Under such circumstances, voluntary project reporting is rarely considered a priority for the use of these limited human and financial resources. Staff considerations often limit the ability to track changes over time. As staff leave and positions are refilled, new staff members may not be aware of past projects and the need for collecting additional post-project data. Finally, DGIF has never provided the conservation community with a central repository where project and effectiveness data can be quickly and easily uploaded for review and reporting purposes.

DGIF addresses several of these issues within the updated Action Plan. In the language above, the authors describe the political situation regarding effectiveness measures and how critical effectiveness data are when dealing with policy and budget authorities. In the following section, the authors detail the importance of adapting conservation actions to both improve performance and address changing conditions. Virginia's Wildlife Action Plan Coordinator served on the teams that developed the Effectiveness Measures Report and the Wildlife TRACS system to help ensure these systems would be compatible with conservation efforts in Virginia. Based upon this work on effectiveness measures, tables

are included within each of the Local Summaries that identify the types of data that would be most useful to demonstrate the effectiveness of individual conservation projects.

DGIF staff also are exploring two opportunities that partners could use to upload project information for review and reporting purposes. First, the Wildlife TRACS development team has repeatedly discussed the need to provide partner organizations with a public access version they could use to promote projects implemented without federal funds. At the time of this writing, other higher priority portions of the Wildlife TRACS system are being developed and tested. This public version will be discussed when the core systems are functional. DGIF staff are also exploring opportunities to promote partner projects within the online version the 2015 Wildlife Action Plan, which will be developed and made available after the Action Plan's approval by the USFWS.

It is important to note that none of these efforts, however, are able to address how partners will prioritize project reporting and effectiveness measures. Additional outreach will be needed to ensure that the conservation community understands the importance of reporting and determine how reporting efforts can be encouraged and facilitated. Financial support may be required to inspire the collection of effectiveness data.

Adapting Conservation Strategies

As conservation projects are implemented and effectiveness data are collected, it is likely that projects will need to be modified, because experience will be gained, circumstances will change, or new information will become available. When fully operational, the Wildlife TRACS system will provide a mechanism to monitor effectiveness and identify issues. If issues or concerns are identified, DGIF and partners will use one of two mechanisms (updating species specific plans or working through DGIF's science teams) to adapt conservation efforts.

Plans or strategies have been developed for several specific SGCN conservation efforts. Examples of plans include the 2007 Virginia Quail Action Plan, the 2011 Canebrake Rattlesnake Conservation Plan, and the 2010 Virginia Freshwater Mussel Restoration Strategy: Upper Tennessee Basin (DGIF 2007; DGIF 2011; DGIF 2010). These plans are created in collaboration with appropriate partners and contributors. If it is determined that conservation actions are not meeting expectations, or if circumstances dictate that conservation objectives must be altered outside of the scope of the original plan, DGIF will coordinate efforts with partners and stakeholders to amend plans as necessary.

During the next decade, DGIF expects many conservation actions will be implemented using the Local Summaries as a guide. Few of these habitat and research efforts are expected to require a more specific or detailed planning document. As these projects are implemented, the Wildlife TRACS system (see above) is expected to provide the necessary effectiveness reporting framework to allow project managers and administrators to track and evaluate project results. Should a program need to be revised to address changing circumstances or new information, DGIF will rely upon its established science teams (see below) to provide program managers with the necessary guidance.

In 2010, DGIF changed its internal divisional structure. This altered structure enhances DGIF's opportunities to employ adaptive management principles. Prior to restructuring, wildlife conservation efforts had been divided among a Wildlife Division that focused on terrestrial game species and terrestrial and wetland habitats, a Fisheries Division that focused on sport fish and aquatic habitats, and a Wildlife Diversity Division that focused on threatened, endangered, and nongame species and their

habitats. During the restructure, these Divisions were merged into a new unit known as the Bureau of Wildlife Resources (Bureau). The Bureau relies upon a series of Science Teams to review, prioritize, and coordinate the implementation of conservation actions. With regards to the Action Plan and revising programs to address changing situations, the Terrestrial Wildlife and Habitat Science Team, the Aquatic Resources Science Team, the Upland Habitat Science Team, and the Conservation Planning Science Team will be responsible for working with program and land managers to review programmatic and project goals, evaluate performance, identify new goals and strategies to achieve those new goals, and describe how new/revised efforts will be evaluated. DGIF staff and administrators will coordinate with staff from the USFWS WSRP before implementing any changes to SWG-funded projects.

Research Needs

While updating the SGCN list (see Methods), partners were asked to describe actions that could be taken to conserve each species. Many partners identified research needs that fell into two categories. The vast majority of research needs involved collecting data to determine the distribution, status, and life history of SGCN. In most of these cases, no additional conservation actions were specified and species were classified as management opportunity "C". In other cases, specific research needs were identified that must be addressed before "on the ground" actions can be implemented to benefit a species. Under these circumstances, species were classified in management opportunity category "B". Absent other criteria, State Wildlife Grant dollars will be prioritized to address research needs for category "B" species. This is not to indicate that no baseline research will be implemented for category "C" species, but this type of research is expected to be a lower priority unless a compelling rationale can be articulated to explain how such an effort would likely lead to the removal of a species from the Action Plan or contribute to a restoration effort. A list of the category "B" species with specific research needs can be found in the Statewide Section.

During the implementation of this Action Plan, other research needs are likely to be identified as projects are developed and carried out. New research needs will be evaluated and prioritized during DGIF's annual budgeting process. If the research involves a species that is not included within the Action Plan, DGIF staff will coordinate with staff from the WSRP to ensure compliance with USFWS guidelines.

Stakeholder and Public Participation

Two of the Eight Essential Elements each Wildlife Action Plan must address involve outreach. Element 7 indicates that, "…Federal, State, and local agencies and Indian tribes that manage significant land and water resources within the State or administer programs that significantly affect the conservation of identified species and habitats…" must be afforded the opportunity to participate in the development, implementation, review, and revision of the Wildlife Action Plan (Public Law 106-291). In addition to the Federal, State, and local agencies and Indian Tribes, DGIF also worked to involve the many private nongovernmental organizations that own conservation lands and easements in Virginia or implement conservation projects consistent with the Wildlife Action Plan. Collectively, these groups are called conservation partners. Element 8 indicates that, "…broad public participation is an essential element of developing and implementing…" Wildlife Action Plans. Throughout the development of the Virginia's 2015 Wildlife Action Plan, the authors have made a significant effort to engage and address the needs/ interests of both the conservation partners and the general public.

Conservation partners were contacted in phases. The first group included partners that have been actively involved in implementing Virginia's 2005 Wildlife Action Plan. These meetings began in October of 2013 and continued through December 2014. These meetings were designed to inform partners that the Action Plan was being updated, describe the problems encountered while implementing the original Action Plan, discuss changes that would be made to address those problems, and to solicit feedback and cooperation. Table 2.1 lists the various agencies and groups that were contacted during this timeframe to set up a meeting via conference call or in-person (**bolded** are entities with which the co-authors met in-person or on the phone). The majority of these meetings lasted two hours. The Action Plan authors also met multiple times over the course of the Action Plan's development with many of these partners, including the Virginia Department of Conservation and Recreation's Natural Heritage Program, the Virginia Department of Forestry, and the Eastern Virginia Rivers National Wildlife Refuge Complex.

Table 2.1. First Phase Conservation Partners.

Federal	State	Regional/NGO
USFWS, Great Dismal Swamp National Wildlife Refuge	**Virginia Department of Conservation and Recreation, Planning and Recreation Resources**	**North Atlantic Landscape Conservation Cooperative**
NPS, Shenandoah National Park	**Virginia Department of Conservation and Recreation, Natural Heritage Program**	**Southeast Atlantic Slope Mollusk Group**
USFWS, Eastern Virginia Rivers National Wildlife Refuge Complex	**Virginia Department of Forestry**	Appalachian Landscape Conservation Cooperative
USFWS, Potomac River National Wildlife Refuge Complex	**Virginia Department of Environmental Quality, Coastal Zone Management Program**	**South Atlantic Landscape Conservation Cooperative**
USFWS, Ecological Services Staff		**Appalachian Mountain Joint Venture**
USFWS, Blackwater National Wildlife Refuge		**TNC, Allegheny Highlands Program Coordinator**
USFS, George Washington/Thomas Jefferson National Forests		**TNC, Southern Rivers Program Director**
USFWS, Back Bay National Wildlife Refuge		**TNC, Clinch River Program Coordinator**
USFWS, Chincoteague National Wildlife Refuge		**TNC, Chesapeake Rivers Coordinator**
USFWS, Wildlife and Sportfish Restoration Program, Region 5		**TNC, Associate State Director for External Affairs and Senior Conservation Scientist**
USFWS, Eastern Shore National Wildlife Refuge		
DoD, Marine Corps Base Quantico		
DoD, Natural Resources Program		
DoD, Naval Air Station Oceania		
DoD, Readiness and Environmental Protection Integration Program		
NRCS, Virginia State Office		

The second group of conservation partners contacted included three types of agencies or organizations. The first type included NGOs that expressed interest in being involved with the planning process. The second group included state natural resource agencies that had not chosen to participate in past efforts related to the Action Plan. The final group included local land use planning agencies. DGIF would like to partner more directly with the local land use planning agencies. Unfortunately, with over 100 cities and counties in Virginia, it was not feasible to meet with every member of this community. Instead, the authors contacted a subset of Virginia's Planning District Commissions representing urban and rural jurisdictions. Each of the following organizations was contacted and offered an opportunity to meet and discuss this planning effort. Specifically, these meetings were designed to help participants understand the goals of the Action Plan and the information the plan would provide. The authors took these

opportunities to better understand the other organizations' needs and how those could be accommodated within the updated Action Plan (Table 2.2). **Bolded** entities indicate a meeting was held, either in person or via phone call. The first of these meetings occurred in July 2014 and the last in December of 2014. The majority of these meetings lasted two hours.

Table 2.2. Second Phase of Conservation Partners.

State Agency	Organizations	Planning District Commissions
Virginia Marine Resources Commission	**Xerces Society**	**Richmond Regional Planning District Commission**
	Chesapeake Bay Conservancy	**Hampton Roads Planning District Commission**
	Virginia Institute of Marine Science	**Northern Virginia Regional Commission**
		Accomack/ Northampton Planning District Commission
		Northern Neck Planning District Commission
		George Washington Planning District Commission
		Middle Peninsula Planning District Commission
		Crater Planning District Commission

In October of 2014, the authors distributed a list of proposed species to be included as Species of Greatest Conservation Need within the update Action Plan. In addition to a wide range of DGIF staff, this list was distributed to conservation partners known to work directly with species and habitat conservation efforts. Recipients were provided with a set of guidelines explaining the draft prioritizations and instructions regarding how to recommend any changes to this list. Recipients were invited and encouraged to distribute this list to any other individuals or organizations they thought might be interested in participating in this effort. Table 2.3 lists all conservation partners that received the proposed SGCN list from the authors for review.

Table 2.3. Conservation Partners that Reviewed Proposed SGCN List.

Federal	State	NGO/ Other
USFWS, Eastern Virginia Rivers National Wildlife Refuge Complex	Virginia Department of Conservation and Recreation, Natural Heritage Program	Appalachian Mountain Joint Venture
USFWS, Potomac River National Wildlife Refuge Complex	Virginia Department of Forestry	Atlantic Coast Joint Venture
USFWS, Ecological Services Staff	Virginia Marine Resources Commissions	Virginia Audubon Society
USFS, George Washington/ Thomas Jefferson National Forests	Virginia Institute of Marine Sciences	TNC, Chesapeake Rivers Program
USFWS, Eastern Shore National Wildlife Refuge		TNC Senior Conservation Scientist
USFWS, Chincoteague National Wildlife Refuge		TNC, Clinch River Program
USFWS, Back Bay National Wildlife Refuge		TNC, Allegheny Highlands Program
NRCS, Virginia State Office		TNC, Southern Rivers Program
NPS, Shenandoah National Park		Eastern Brook Trout Joint Venture
USFWS, Blackwater National Wildlife Refuge		Virginia Society of Ornithology
USFWS, Great Dismal Swamp National Wildlife Refuge		Xerces Society

On May 1, 2015, DGIF made the draft 2015 Wildlife Action Plan available to conservation partners and the public via the DGIF website at: and http://www.bewildvirginia.org/wildlife-action-plan/draft/ and http://www.dgif.virginia.gov/. To announce that these materials were available, the authors sent email notifications to the following agencies, conservation partners, and tribes (Table 2.4).

Table 2.4. Conservation Partners that Received the Draft 2015 Virginia Wildlife Action Plan for Review.

DCR, Natural Heritage Program	DCR, Planning and Recreational Resources	DOF, Virginia Department of Forestry
DEQ, Coastal Zone Management Program	DEQ, Division of Environmental Enhancement	Virginia Marine Resources Commission
Virginia Institute of Marine Science	Virginia Department of Transportation	Virginia Department of Agriculture and Consumer Services
USFWS, Virginia Field Office	USFWS, Southwest Virginia Field Office	USFWS, Chesapeake Bay Field Office
USFWS, Eastern Virginia Rivers National Wildlife Refuge Complex	USFWS, Back Bay National Wildlife Refuge	USFWS, Potomac River National Wildlife Refuge Complex
USFWS, Blackwater National Wildlife Refuge	USFWS, Great Dismal Swamp National Wildlife Refuge	USFWS, Chincoteague National Wildlife Refuge
USFWS, Eastern Shore National Wildlife Refuge	NRCS, Virginia State Office	DoD, Marine Corps Base Quantico
DoD, Naval Air Station Oceania	DoD, Readiness and Environmental Protection Integration Program	DoD, Natural Resources Program
US Geological Survey	Appalachian Mountain Joint Venture	USFS, George Washington and Thomas Jefferson National Forests
NPS, Shenandoah National Park	NPS, Appalachian National Scenic Trail	NPS, Appomattox Court House National Historic Park
NPS, Booker T. Washington National Monument	NPS, Colonial National Historical Park	NPS, Fort Monroe National Monument
NPS, Fredericksburg and Spotsylvania National Military Park	NPS, George Washington Birthplace National Historic Park	NPS, New River Gorge National River
NPS, Maggie L. Walker National Historic Site	NPS, Petersburg National Battlefield	NPS, Richmond National Battlefield Park
North Atlantic Landscape Conservation Cooperative	South Atlantic Landscape Conservation Cooperative	Appalachian Landscape Conservation Cooperative
Atlantic Coast Joint Venture	American Fisheries Society, Virginia Chapter	B.A.S.S. Federation Nation of Virginia, Inc.
Chesapeake Bay Foundation	Chesapeake Data LLC	Coastal Conservation Association
Ducks Unlimited	Eastern Brook Trout Joint Venture	Friends of Dyke Marsh
Virginia Society of Ornithology	Friends of the Rappahannock	Friends of the Rivers of Virginia
Garden Club of Virginia	Izaak Walton League	James River Association
National Wild Turkey Federation, Virginia	New River Land Trust	Northern Virginia Conservation Trust
Piedmont Environmental Council	Sierra Club - Virginia Chapter	The Wildlife Foundation of Virginia
TNC	Virginia Native Plant Society	Virginia Association of Counties
Virginia Audubon Council	Virginia Conservation Network	Virginia Council of Trout Unlimited
Virginia Deer Hunters Association, Inc.	Virginia Farm Bureau	Virginia Herpetological Society
Virginia Municipal League	Virginia Outdoors Foundation	Wetlands Watch
Wild Virginia	Wildlife Center of Virginia	XERCES Society
Virginia Master Naturalists	Accomack-Northampton Planning District Commission	Central Shenandoah Planning District Commission
Commonwealth Regional Council	Crater Planning District Commission	Cumberland Plateau Planning District Commission
George Washington Regional Commission	Hampton Roads Planning District Commission	Lenowisco Planning District Commission
Middle Peninsula Planning District Commission	Mount Rogers Planning District Commission	New River Valley Planning District Commission
Northern Neck Planning District Commission	Northern Shenandoah Valley Regional Commission	Northern Virginia Regional Commission
Rappahannock-Rapidan Regional Commission	Region 2000 Local Government Council	Richmond Regional Planning District Commission
Roanoke Valley-Alleghany Regional Commission	Southside Planning District Commission	Thomas Jefferson Planning District Commission
West Piedmont Planning District Commission	Chesapeake Conservancy	The Wildlife Society, Virginia Chapter
Virginia Outdoor Writers Association	Absentee Shawnee Tribe of Oklahoma	Catawba Nation
Cherokee Nation of Oklahoma	Delaware Nation of Oklahoma	Delaware Tribe of Indians
Eastern Band of the Cherokee Indians	Eastern Shawnee Tribe of Oklahoma	Shawnee Tribe
Tuscarora Nation	United Keetoowah Band of Cherokee Indians in Oklahoma	

Following the release of the draft 2015 Action Plan for review, and the distribution of the announcement emails, recipients suggested that DGIF notify other potentially interested parties. These included Virginia's Environmental Educators, the Virginia Union of Land Trusts (VaULT), and the state recognized tribes. An announcement email was sent to the Environmental Educators on May 7. A comprehensive contact list for VaULT members could not be found until May 11. The authors spent several days trying to find appropriate contact information for the state recognized tribes, but were unsuccessful. On July 16, the authors were notified that the Pamunkey Tribe had become federally recognized and the USFWS was able to provide contact information for the tribal leadership. A letter was sent to the Pamunkey Tribe advising them of the Action Plan. This letter included an offer to meet to discuss the plan with tribal representatives.

In an attempt to distribute the Action Plan to a larger public audience, the authors worked with DGIF's outreach staff to post an announcement on DGIF's Facebook page. The Facebook posting resulted in 2466 Views, 116 Likes, and 25 Shares. DGIF considered issuing a press release to announce the Action Plan's availability. The DGIF's Media Manager indicated that Virginia's media outlets monitor Facebook, which has become a common method of distributing information to the media. However, to ensure media distribution, an announcement was sent directly to the membership of the Virginia Outdoor Writers Association. These efforts resulted in one interview with a reporter from the Winchester Star newspaper. During a discussion with DGIF's Media Manager, the authors expressed disappointment with the limited response. The authors were informed this level of response was consistent with the level of response received on posts regarding similar topics.

In another attempt to distribute the Action Plan to a larger public audience, the authors worked to give presentations to a variety of groups regarding the purpose of the Action Plan. The authors requested DGIF staff and other partners help identify opportunities to give presentations to conservation partners and public audiences. Between October 2013 and August 2015, the authors were invited to give presentations to the Garden Club of Virginia, the Roanoke Valley Bird Club, the Roanoke Izaak Walton League, the Adult Forum Program for St. George's Episcopal Church in Fredericksburg, Virginia, and the Chesapeake Bay Foundation's Richmond Supper Club. These presentations all involved discussions of the Wildlife Action Plan which included describing how climate change would be addressed, how the updated Action Plan would be formatted, types of threats to wildlife and habitats that would be included, and types of actions that can be taken to address these issues. Each of these meetings was open to the public and audiences ranged in size from 20 individuals to 120 individuals. During each presentation, the presenter offered to meet with other groups at other events as needed.

Additional presentations were given to the joint annual meeting of the Virginia/West Virginia Chapters of the American Fisheries Society (approximately 150 participants), the Crater Planning District Commission's Quarterly Planning Director's Meeting (8 participants), the joint meeting of the Northern Neck Planning District Commission, the Northern Neck-Chesapeake Bay Region Partnership, and the Northern Neck Tourism Commission (40 participants), and the Commonwealth Planning Region's Chief Administrative Officers Committee meeting (9 participants).

The Action Plan's authors submitted an article for the Virginia Master Naturalists newsletter, *The Pollinator*. The article was distributed in July 2015, and the newsletter has an estimated total circulation of 1800 households. The article focused on the history of the Action Plan, its updated format, threats, conservation actions, and opportunities for Master Naturalist chapters to become involved with Action Plan implementation. The Action Plan authors were also contacted by the Green Infrastructure Center to

collaborate on a training curriculum to help local land use planners incorporate the updated Action Plan with local land use plans and green infrastructure plans.

The updated Wildlife Action Plan was presented to the Virginia Board of Game and Inland Fisheries on August 20, 2015. This meeting was open to the public, and the public was provided an opportunity to comment on the draft Action Plan during this event. One member of the public elected to provide a formal comment praising the action plan and encouraging DGIF to continue efforts to improve habitats in southeastern Virginia using fire. The Board of Game and Inland Fisheries voted to endorse the updated Wildlife Action Plan.

DGIF Involvement

When Virginia's original Action Plan was written, the planning effort was directed by the Wildlife Diversity Division. The Wildlife Diversity Division consisted of programs related to threatened and endangered species, nongame species conservation, environmental commenting, watchable wildlife, geospatial analysis, and data management. During 2010, DGIF executed a significant restructuring of its wildlife resource programs. Per this restructure, the former Wildlife Diversity Division was merged with the former Fisheries Division, which managed sportfish resources, and the former Wildlife Division, which managed terrestrial game species and habitat resources. These three divisions, Wildlife Diversity, Fisheries, and Terrestrial Wildlife, became the Bureau of Wildlife Resources. Functions and procedures within the Bureau are distinctly different from those used during the previous agency structure. These changes are significant in terms of how DGIF prioritizes projects and allocates State Wildlife Grant dollars.

In updating the Action Plan, to develop an effective and comprehensive document, it was imperative to ensure that the diversity of Bureau programs and personnel had the opportunity to participate in this planning effort. DGIF staff members are an important conservation partner and, as such, were treated as a target for outreach efforts consistent with the guidance of Element 7.

Between October 2013 and March 2014, the Action Plan authors met with the Bureau's Administrative Team, the Bureau's Threatened and Endangered Species Committee, the terrestrial biologists and administrators from each of DGIF's four management regions, the aquatic biologists and administrators from each of DGIF's four management regions, and DGIF's Media Manager. These meetings were scheduled to announce the update of the Action Plan, describe issues encountered with the original Action Plan, the process that would be used to create the updated plan, and to notify staff of the opportunities they would have to participate in the update process.

Between April 2014 and June 2014, the Action Plan authors coordinated meetings with DGIF staff to discuss habitat concerns. Specifically, meetings were held to discuss how habitats should be identified and classified within the updated Action Plan, what issues threatened the viability of those habitats, and what actions could be taken to address those threats. Meetings were held to discuss coastal/marine habitats, wetland habitats, forest habitats in eastern Virginia, forest habitats in western Virginia, karst habitats, open habitats (including grassland, shrub land, post-agricultural, glade, and savanna habitats), and aquatic habitats in DGIF's four management regions. Each of these meetings required two to five hours. At several times during this process, the Action Plan authors met with the Bureau's senior administrators to update them on the planning process and issues that needed to be addressed. Meetings with DGIF staff and administrators were extraordinarily helpful in that they helped the authors

develop the first draft of narratives and materials that facilitated discussions with Conservation Partners and the writing of the final Action Plan.

On April 14, 2015, two weeks before the draft Action Plan was made available to the general public, the draft Action Plan was made available to Bureau staff for review and comment. This provided an additional opportunity to find typographical errors, identify issues with species distributions, and clarify narratives regarding habitats, conservation threats, and actions.

Summary of Comments and Action Plan Adaptations

Thirteen members of DGIF staff and fourteen outside individuals and organizations provided comments on the draft Action Plan. Generally, comments were positive and complimentary of the new format. For example:

> "On the whole this is an excellent plan that shows a lot of thoughtful "big picture" consideration of ecosystem conservation. I applaud the shift from a focus on single species to a concern for habitat conservation. I especially applaud the recognition of climate change and its implications for wildlife. In today's political climate, this is a courageous step."
>
> "It's very well researched, comprehensive, and informative."
>
> "The plan overall looks great I think. You have digested what you and others saw as challenges (to implementation) in the last WAP, and worked very hard to materialize those into improvements in this plan. "

Other categories of comments Included:

- The most common comments involved typographical mistakes, which were corrected.
- Some reviewers notified DGIF of changes made to either the common name or scientific name for some species. These comments were reviewed and corrected as directed. Such changes were forwarded to the biologists that maintain the Virginia Fish and Wildlife Information System.
- Several reviewers identified species distribution errors within the Local Summaries. Each of these comments was reviewed and Local Summaries were corrected as needed.
- Some reviewers expressed concerns regarding the prioritization of specific species. If sufficient information was provided (see section on updating the SGCN list) changes were made. If insufficient data was provided, reviewers were contacted to request additional information.
- Several reviewers provided additional details about conservation properties identified within the Local Action Plan Summaries. Properties were added or removed from these lists as directed.

- Several DGIF staff requested language be added to identify white-tailed deer as a threat impacting forest habitats in specific planning regions. Working with the appropriate district biologist and one of DGIF's Deer Program Managers, text was drafted and included as needed to indicate the impacts deer have on forest habitats and the conservation actions that can be taken to address these issues.

- Several reviewers correctly identified that the draft Action Plan failed to discuss the issue of habitat connectivity for either aquatic or terrestrial habitats. This was an unfortunate oversight which the authors are working to correct. Information on aquatic connectivity has been added to the Statewide Section and the appropriate planning region chapters. At this time, no prioritization tool exists for Virginia's rivers that flow into the Mississippi River drainage. These data will be incorporated into the online version of the Action Plan as they become available. Regarding the connectivity of terrestrial habitats, at the time of this writing, DGIF is collaborating with the North Atlantic Landscape Conservation Cooperative to identify Regional Conservation Opportunity Areas for the 13 northeastern states. Connectivity is a key factor being considered in this effort and these data will be incorporated into the online version of the Action Plan as they become available.

- One reviewer correctly identified a flaw in the process used to identify priority watersheds within each of the local planning regions. The draft Action Plan only identified watersheds as priorities for restoration. No information was provided to identify healthy watersheds that would be conservation priorities in their current state. To address this issue, the authors met with representatives from the Virginia Natural Heritage program to discuss the Virginia Healthy Waters Initiative. Following this meeting, the Statewide Section and each of the planning region chapters were updated to include narrative and maps from the Virginia Healthy Waters Initiative. New materials will be added to the online version of the Action Plan as the Virginia Healthy Waters Initiative is updated in 2015 and 2016.

- Planners from the Central Shenandoah Planning Region contacted DGIF to discuss a particularly troublesome habitat threat near the town of Elkton, Virginia. After discussing and conferring with the town planner, this project was added to the Local Summary as a priority project.

- The updated Action Plan prioritizes species both by their level of imperilment and conservation opportunity. Each SGCN is assigned to one of three conservation opportunity scores: A, B, or C. Category B identifies species that either have specific research needs or "on the ground" conservation actions have been identified that cannot currently be implemented due to a lack of funding, personnel, or other resources. One reviewer suggested that category B was too broad and could be misleading to readers. They suggested adapting the conservation opportunity rankings so that category B would be broken into more descriptive subcategories. The authors understand this concern and also recognize that the conservation opportunity ranks will need to change over time as this Action Plan is implemented. Rather than complicate an untested system, the list of SGCN provided within this Action Plan (see Appendix A) has been expanded to include a notes section to indicate why each conservation opportunity ranking was assigned to each SGCN. Modifications to the conservation opportunity categories will be considered when the Action Plan is updated.

In summary, those individuals that commented on the draft Action Plan provided significant feedback and insights that have helped improve the quality and utility of the document. As the updated Action Plan is implemented, DGIF staff and others will continue collaborating with Conservation Partners and working to inform the general public about the wildlife conservation efforts implemented on their behalf.

Update of Virginia's Wildlife Action Plan

Congress requires that each state describe the procedures that will be used to review and update their Action Plan at intervals not to exceed ten years (Public Law 106-291). Virginia will complete a comprehensive and formal revision of Virginia's Wildlife Action Plan by October 2025. The exact process for updating this Plan will be determined closer to that deadline. The process will, however, be developed in close consultation with DGIF administrators, DGIF staff, the USFWS, other agencies, and partners. As indicated previously, DGIF will continue its annual reporting of projects and accomplishments. When reporting on projects funded via State Wildlife Grants, DGIF will provide data on project outputs and effectiveness measures per the standardized metrics developed by AFWA and the Wildlife TRACS system. If indicated by the effectiveness and project output data, projects and programs may be altered to better address changing conditions. Efforts may also be adjusted as new technologies, data, or conservation strategies become available. If circumstances require the Action Plan be revised prior to the 10-year deadline, DGIF staff will coordinate efforts with the appropriate representatives of the USFWS' WSFR Program.

3. Statewide Overview

Species Summary

Virginia's 2015 Action Plan includes a list of 883 SGCN. DGIF and partners recommended that 89 of the species included in the 2005 Plan be removed from the SGCN list. In most of these cases, species were found to be more abundant than previously thought based on information gathered after the original Action Plan was published. Unfortunately, of these species, the green blossom pearly mussel is believed to have gone extinct since the Action Plan's publication and the Appalachian Bewick's wren is no longer found in Virginia.

Partners recommended adding 48 new species to the revised Action Plan SGCN list for a variety of reasons. Seven new bats were included to reflect the impacts of white-nose syndrome, a disease which did not exist in 2005. Species such as the common snapping turtle and marine mammals are being included to highlight actual and potential population declines due to human use and habitat development concerns. Seven bumble bees and the monarch butterfly have also been added in recognition of international declines in these pollinator populations.

DGIF biologists and partners also reviewed the remaining SGCN from the 2005 Action Plan and determined they should remain within the 2015 Wildlife Action Plan. Two dozen of these species were assigned a new Tier rank to indicate changes in their condition or circumstances. Additionally, the American Fisheries Society updated the taxonomy for several species of fish, mollusks, and crustaceans. As such, a handful of species may appear to be new additions to the Action Plan while they are, in fact, species that were formerly included under different names. The number of species within each taxonomic group and tier are identified within Table 3.1.

Table 3.1. Number of SGCN per Taxonomic Group by Tier.

Taxonomic Group	Tier I	Tier II	Tier III	Tier IV	Total
Amphibians	5	8	8	11	32
Reptiles	8	4	7	14	33
Fishes	18	8	19	50	95
Birds	14	13	18	35	80
Mammals	11	5	3	14	33
Aquatic mollusks	29	17	17	25	88
Aquatic crustaceans	9	26	14	4	53
Aquatic insects	5	24	39	80	148
Other aquatic invertebrates	5	4	1	2	12
Terrestrial insects	10	35	25	57	127
Other terrestrial invertebrates	7	70	35	72	182
Total	**121**	**214**	**186**	**362**	**883**

In addition to updating the Tier rankings to describe level of imperilment, each species was assigned a Conservation Opportunity Rank of A, B, or C (see Methods and Approach Section). This new prioritization scheme helps managers focus attention on species with specific management needs and

opportunities. Of the 883 SGCN identified within the 2015 Action Plan, 23.4 percent are classified as Category A, indicating that managers have identified on the ground strategies to manage either the species or its habitat. Another 7.1 percent of the 2015 list of SGCN are classified as Category B, indicating either specific research is needed to facilitate on the ground action or on the ground opportunities cannot be implemented at this time due to a lack of resources. The remaining SGCN (69.5 percent) are classified as Category C, indicating managers have not identified on the ground strategies or specific research needs that will facilitate on the ground action. Species also were assigned to Category C when available conservation opportunities have been exhausted. It should be noted that baseline life history and distribution data are lacking for many of the SGCN. Given the broad nature of this research need and the difficulty of evolving such efforts into an on the ground management strategy, these species were classified as Category C.

The Tier and Conservation Opportunity Rankings are provided for SGCN within Appendix A. Appendix A also provides a brief explanation regarding why each species was assigned to a tier and conservation opportunity category. The SGCN that occur within each planning region are identified within the Local Action Plan Summaries.

Species Status

The USFWS and DGIF track the status of many species with regards to the federal and state Endangered Species Acts. Species may be designated as being threatened or endangered at the state and/ or federal level. Species may also be designated as being "proposed" for protection, a "candidate" species, a "species of concern", or a species of "collection concern." An individual can be assigned to a single category or multiple categories. Virginia's Fish and Wildlife Information Service indicates which species have been assigned to each of these categories. Of the 883 Action Plan species, 220 (24.7 percent) have been assigned to one or more of these additional categories (Table 3.2).

Table 3.2. Species with State and Federal Threatened or Endangered Status.

# of Species	Classification	DGIF Coding
58	Federal Endangered/State Endangered	FE/SE
10	Federal Threatened/State Threatened	FT/ST
1	Federal Threatened/State Endangered	FT/SE
12	Federal Species of Concern/State Endangered	FS/SE
9	Federal Species of Concern/State Threatened	FS/ST
22	State Endangered	SE
24	State Threatened	ST

HABITAT SUMMARY: DESCRIPTIONS, STATUS, THREATS, AND CONSERVATION ACTIONS

Virginia boasts a broad diversity of habitats from beaches, dunes, and mudflats in the east to spruce-fir forests in the west. While it is convenient to think of habitats as isolated and self-contained communities, they are in fact interconnected and interdependent. Healthy upland habitats contribute to the quality of riparian and aquatic habitats. Likewise, the condition and quality of upstream habitats influences the health of downstream and marine habitats. The key factor linking these habitats together is water. Given the importance of water to terrestrial and aquatic habitats, conservation actions in this

section and in the Local Summaries have a significant focus on water quality and maintaining that quality through habitat management and habitat restoration. Thus, actions in this Plan encompass a broad range of targets and provide opportunities for a diversity of partners. Other habitat specific actions are also important and included within the Action Plan, but water quality issues can be found across all habitat types.

A number of models have been developed to identify habitat types and describe their condition. Some models, such as the ecoregional descriptions produced by the USEPA describe areas of discreet biotic and abiotic conditions across large regional areas (Griffeth et al. 1999). The Natural Communities of Virginia: Classification of Ecological Community Groups is based on assemblages of co-existing, interacting species that are considered together with the physical environmental and associated ecological processes (Fleming et al. 2013). The National Land Cover Dataset (NLCD) has a finer spatial resolution than ecoregions and describes the landscape using over 20 different coarse land cover classes (Fry et al. 2011). The Nature Conservancy through the Northeast Terrestrial Habitat Map (NEHTM) and others have developed habitat models at a fine spatial resolution, using narrowly defined land cover classes (Anderson et al. 2013). However, the NETHM (as well as other spatial data sets such as NLCD, LANDFIRE, etc.) is primarily useful as a coarse-scale spatial planning tool, and it should not be relied upon, or at a minimum needs adaptation to be used, at finer scales (e.g., local level) for planning specific restoration and management actions. The NETHM lacks a comprehensive accuracy assessment and has been shown to inaccurately classify a number of reference sites into developed classes (Simon, personal communication). However, Virginia DGIF conducted an accuracy assessment for the NETHM within Virginia. Results demonstrated that at the ecosystem level, accuracy is approximately 50 percent, while accuracy improves to almost 80 percent when considering macrogroups or other similar habitat types (Klopfer and McGuckin 2014). This is understandable given its use of Forest Inventory Assessment (FIA) data which are underrepresented at finer spatial scales and for less common systems/habitats. Finer resolution mapping products have been developed by partners (e.g., ecological zones) and should be evaluated for local planning purposes (especially in the western and southwestern portions of the state).

This Action Plan borrows from these conservation models and tools and adapts their habitat data to best suit the needs of land and water managers. The Action Plan provides a crosswalk between the habitat definitions from the NETHM classification system to ensure this Action Plan is useful to all conservation practitioners as well as to demonstrate how the model classification can be used by land managers. Eight basic habitat types are described and referenced within this Action Plan. Within these habitat types, several other habitat subcategories are described. Habitats in this Action Plan include:

- Beaches, Dunes, and Mudflats
- Tidal wetlands
- Non-tidal wetlands
- Freshwater aquatic and riparian habitats
    - Tidally influenced warm water streams and rivers
    - Coldwater streams and rivers
    - Non-tidal warm water streams and rivers
    - Blackwater streams and rivers
- Open habitats
    - Post-agricultural lands
    - Glades and barrens
    - Pine and oak savanna

- Mixed hardwood/ conifer forests
    - Young forests
    - North Atlantic coastal plain maritime forest
    - Central Atlantic coastal plain maritime forest
    - Southern Atlantic coastal plain upland longleaf pine woodland
    - Southern Appalachian low elevation pine forest
- Spruce fir forests
- Karst and subterranean habitats

These habitat types were identified based on the meetings with DGIF staff and conservation partners (see Methods Section). Information about these habitats, threats that affect habitat quality, and actions that can be taken to address these threats at a statewide level are described below.

Beach, Dune, and Mud Flat Habitats

Beaches, dunes, and mudflats are found along Virginia's coasts and barrier islands. Beach and dune vegetation is limited in distribution by the interaction between winds, changing sands, and wave action and also by the need to be salt-tolerant. Trees and shrubs, for example, are restricted to growing only in sheltered areas (Anderson et al. 2013). Moisture is maintained through salt spray and rain events. Virginia has over 3,300 miles of coast along the Atlantic Ocean and the Chesapeake Bay (DEQ 2014). Beaches and dunes are found in all four of the coastal planning regions adjacent to the Chesapeake or the Atlantic, but these habitats are relatively rare.

Much of Virginia's Atlantic beach and dune habitats on the Eastern Shore have been conserved by a combination of state, federal, and private entities. This area is known as the Virginia Coast Reserve. South of the Chesapeake Bay, along the Atlantic Coast of mainland Virginia, areas of beach and dune habitats are conserved within Back Bay National Wildlife Refuge and First Landing State Park. With a large amount of beach habitat under conservation, business and industrial development is not a significant a threat for this area of Atlantic beaches and dunes. Sea-level rise and land subsidence, however, are considered to be a threat. Several climate models indicate ocean levels could rise by three feet or more by 2100, potentially leaving hundreds of acres of Virginia's shorelines vulnerable to inundation (VIMS 2013).

Residential development is a concern on the Bayside of the Eastern Shore and other portions of Virginia's coastline. Building homes, roads, and other structures, combined with increasing levels of human activity, can impact beach nesting species and diminish the quality of these coastal habitats.

Partners also expressed concerns related to landowner and community efforts to protect developed areas from wind and wave activity. Coastal areas are dynamic with beaches and dunes shifting and migrating as they are influenced by wind, waves, and other factors. These shifting shorelines can threaten homes and other structures. Shoreline hardening, or the use of solid bulkheads or boulders to disrupt the natural movement of shorelines, is a relatively quick and economical way to protect these developed areas (NRC 2007; Kane 2011). Unfortunately, hardened shorelines limit wildlife use and access and, as sea levels rise, prevent beach migration, often resulting in beach habitats being submerged and lost. Invasive species, such beach vitex (*Vitex rotundifolia*), are also problematic for beaches and dunes as they can alter the shifting nature of dunes, cover beaches, and often eliminate native plants that are beneficial to wildlife.

There are three primary actions that will help conserve the quality and longevity of Virginia's beach and dune habitats. The first includes working with communities to manage human activities on beaches and dunes at specific times when wildlife, such as beach nesting birds and sea turtles, are most vulnerable to disturbance. This management action may not need to result in permanent human exclusion.

As noted earlier, beaches and dunes are active and dynamic habitats that move in response to wind and wave activity. If prevented from moving, these relatively rare habitats can be submerged or overgrown and converted into other, more common, habitats that do not support the unique set of beach and dune-dependent species. Preventing development and refraining from shoreline hardening in areas inland and adjacent to existing beach and dune systems would help ensure the long-term persistence of these systems as sea levels continue to rise and lands continue to subside.

The third action includes focusing on invasive species and predator control. Virginia's beaches, dunes, and mudflats are recognized as internationally important areas for migrating birds and other species (TNC 2015). The degradation of these habitats by invasive plants, or the disruption of nesting by predation, can have profound impacts on wildlife populations. It is important that conservation partners work to eradicate invasive plants as they are detected, prevent the introduction of new invasive species, and limit avian and mammalian predators as needed to support beach and dune nesting species.

Wetland Habitats

The term "wetlands" refers to a complex combination of habitats. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and human disturbance. USEPA regulations define wetlands as, "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions (40 CFR 230.3(t))." Wetlands are frequently classified by the types of vegetation they support: emergent, shrub/scrub, and forested.

Across Virginia, there are approximately one million acres of tidal and non-tidal wetlands (DEQ 2014). Tidal wetlands are made up of both salt and brackish marshes that are dominated by grasses, forbs, and sometimes shrubs, and they are found along Virginia's coastal areas (Comer 2003). They also include tidally influenced swamps. Approximately 236,000 acres of tidal wetlands remain in Virginia (DEQ 2014). Tidal marshes are found in all eight coastal planning regions. Depending upon the planning region, they may occupy as little as 0.1 percent to approximately 8.0 percent of the land area.

The second wetland type within Virginia is freshwater, non-tidally influenced wetland. These freshwater, nontidal wetlands include a diversity of emergent, scrub/shrub, and forested wetland and swamps (Anderson et al. 2013). Freshwater systems are dynamic habitats which, as they age, can change from emergent to shrub, or forested forms. Freshwater wetlands can also include spring seeps in the mountains, sink hole ponds, vernal ponds, and other forest wetland communities. Approximately, 808,000 acres of non-tidal wetlands remain in Virginia (DEQ 2014). Non-tidal wetlands are found across all of Virginia and all planning regions. However, they often constitute a small portion of the total land cover within any given planning region.

Virginia has lost approximately 40 percent of all its precolonial wetlands (DEQ 2014). Of Virginia's remaining wetlands, 72 percent are in the Coastal Plain, 20 percent in the Piedmont, and 9 percent in

the rest of the state (DEQ 2014). Wetland habitat quality is severely stressed in the Hampton Roads area and moderately to severely stressed around Richmond, Fredericksburg, and Northern Virginia (CZM 2011). Additionally, wetland water quality is also moderately to severely stressed in those same areas as well as much of southeastern coastal Virginia and the Eastern Shore (CZM 2011). Anderson et al. (2013) project a range of approximately 45 to 750 acres of Virginia's freshwater wetlands will be lost per year over the next 50 years.

In addition to their habitat value, wetlands provide many valuable ecosystem services to human communities. Wetlands help prevent nutrients and other harmful materials from flowing into streams, they can protect inland areas from floods and storm surges, and they provide recreational opportunities for hunters, anglers, and wildlife watchers. Four issues represent the greatest threats to Virginia's wetland habitats:

- Degradation of water quality,
- Land conversion/ land use changes,
- Invasive species, and
- Sea-level rise/ inundation.

As discussed previously, the updated Wildlife Action Plan utilizes the Virginia Wetlands Catalog to identify healthy and intact watersheds that are priorities for conservation. Designation of wetland conservation priority areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 3.1) (Weber and Bulluck 2014). DCR also identifies degraded wetlands and prioritizes these areas based upon their restoration potential. The restoration wetlands were identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 3.2) (Weber and Bulluck 2014). Priority areas for conservation and restoration to address the threats described below are highlighted in each Local Summary using the rankings provided by the Virginia Wetlands Catalog. Maps of priority wetlands for conservation and restoration are provided within each Local Summary.

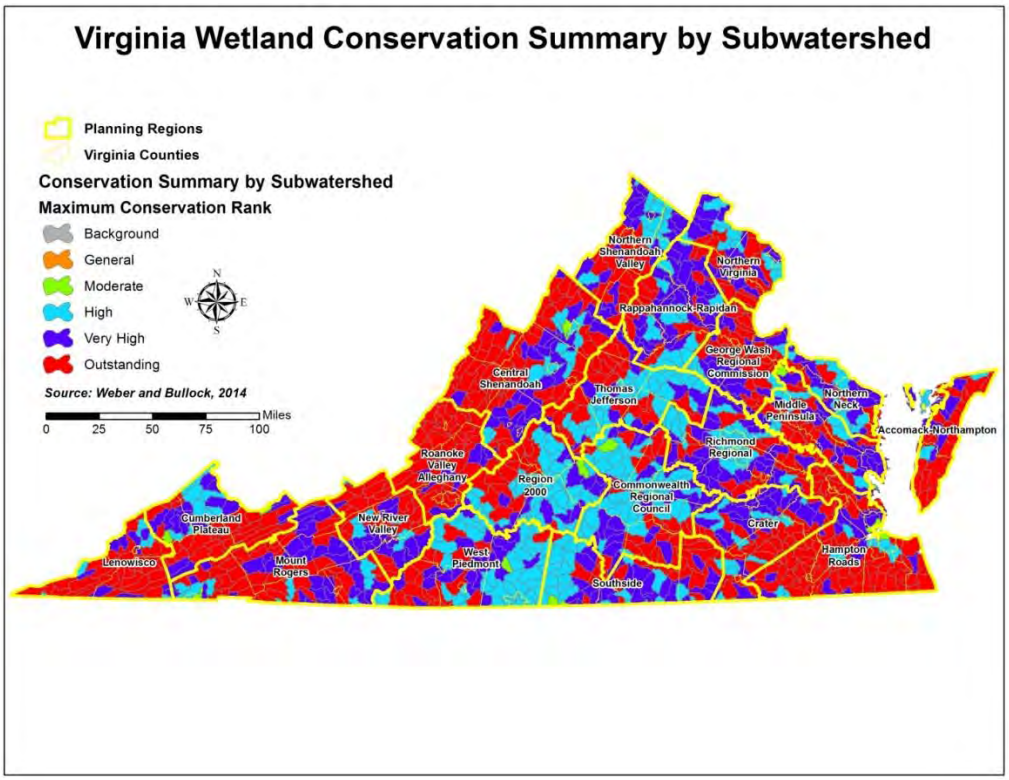

Figure 3.1. HUC12 Watersheds Containing Priority Wetlands for Conservation (Weber and Bulluck 2014).

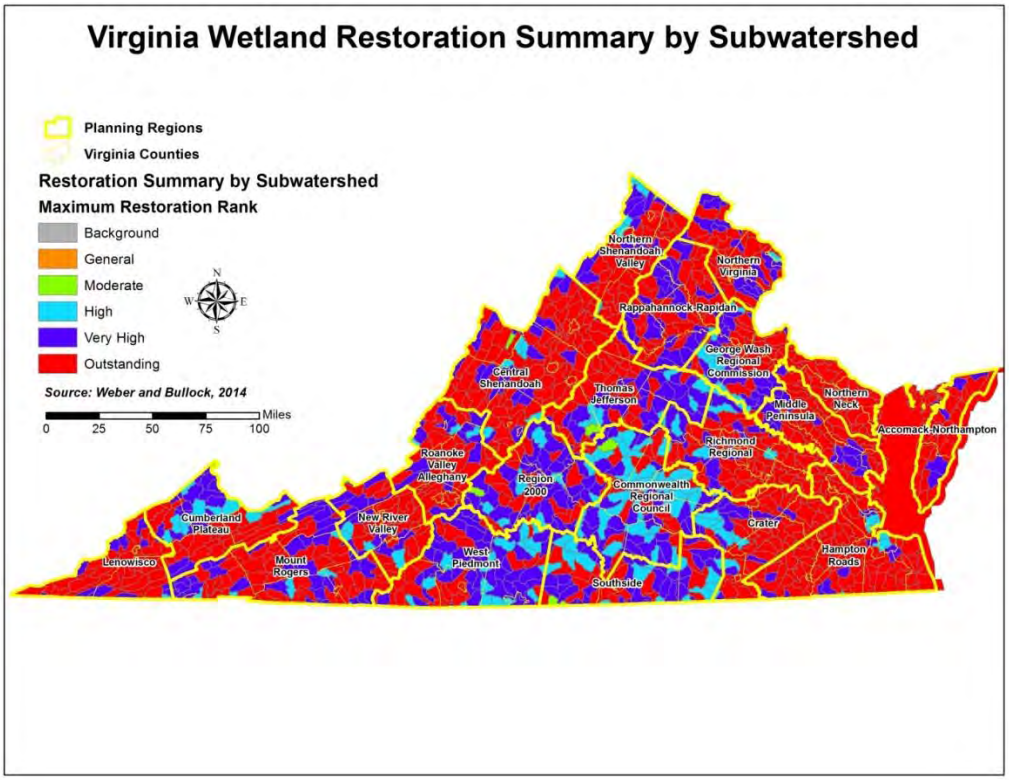

Figure 3.2. HUC12 Watersheds Containing Priority Wetlands for Restoration (Weber and Bulluck 2014).

Wetlands and Water Quality

Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the Commonwealth. The most significant threats to water quality involve sediment, nutrients, chemical pollutants, and fecal matter flowing from the riparian areas and upland habitats into streams, and rivers. Efforts to address water quality issues will also benefit efforts to conserve and restore Virginia's wetland habitats.

Wetlands and Land Conversion/ Land Use Changes

Although Virginia has a no net loss policy that applies to development projects and a permitting process established under the Virginia Water Protection Permit Program, all wetland types can be converted, either intentionally or accidentally, to other land uses. Many non-tidal wetlands are filled and converted to upland habitats that can be used for lawns, agriculture, commercial development, or other purposes. In other cases, the construction of impoundments inundates non-tidal wetlands and result in open water habitats (DEQ 2011). While wetland conversion conducted under a permit often require some form of wetland restoration, enhancement, or mitigation to offset the habitat loss, many small wetlands, which are difficult to map and track, can be quickly and easily inundated or converted with little risk of regulatory action (DGIF personal communication 2014).

The most significant and extensive threat to tidal wetlands involves the filling of wetlands to make areas suitable for residential and other types of development (CZM 2011; DEQ 2011). Sea-level rise and invasive species are also significant threats (CZM 2011). Hydrologic alteration (ditching, channelization, diversions, etc.), which prevents water from getting to the wetlands, and erosion, which fills wetlands, are moderate threats but extensive throughout the region (CZM 2011; DEQ 2011). Pollution is also a problem in much of the state (CZM 2011). Additionally, tracking of the no net loss policy and implemented mitigation is not as well established for tidal wetlands as it is for non-tidal wetlands (CZM 2011).

To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has that authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ or VMRC (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines that can negatively affect wetlands. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods, living shorelines can help protect private property from erosion while also protecting wetland habitats (Kane 2011; VIMS 2010). Establishing or protecting vegetative buffers upland and upstream of wetlands is important to protect the health of existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Although a proportion of tidal and non-tidal wetlands in many planning regions are protected in National Wildlife Refuges and other protected areas, the protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN.

Wetlands and Invasive Species

Scores of invasive species have been introduced into Virginia. These invasive plants and animals often degrade the quality of wetland habitat through damage or loss to wetland vegetation. *Phragmites* is the most damaging invasive plant impacting Virginia's tidal wetlands. This species can out-compete native vegetation, creating a wetland monoculture with diminished function and habitat value. Purple loosestrife and Japanese stilt grass are also widespread in Virginia and degrade the quality of Virginia's freshwater wetlands. Faunal threats include mute swans, nutria, and feral hogs. Once populations of these species become established, they become incredibly difficult and expensive to eradicate (VISWG 2012).

Multiple state and federal agencies work to address invasive species issues within Virginia. Despite this effort, there are insufficient human and financial resources in Virginia to completely eradicate all invasive species. In order to facilitate and enhance the Commonwealth's ability to address invasive species, the Virginia Invasive Species Working Group completed the Virginia Invasive Species Management Plan (VISWG 2012). This document identifies seven goals (each with multiple strategies) for addressing invasive species issues in Virginia, many of which relate to wetlands (See Invasive Species section for more information below).

Wetlands and Sea Level Rise / Inundation

As sea levels rise, wetlands may be inundated and convert to shallow open water habitats. Likewise, non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open water habitats and salt marshes will not support the same vegetative composition as the existing non-tidal and tidal wetlands, affecting the wildlife species that depend on these habitats (CCSP 2009). As botanical communities are degraded by changing conditions, they may become more susceptible to invasive species. Additionally, as storms become more intense, more frequent storm surges and inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Climate-related wetlands conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Freshwater Aquatic and Riparian Habitats

Rivers and streams can be described using a variety of different factors such as flow, temperature, slope, water chemistry, and substrate. In discussions with conservation partners, four important freshwater habitat types were identified: *tidally influenced, non-tidally influenced warm water, cold water, and blackwater*.

Tidally influenced rivers experience some degree of tidal action. Salinity levels can vary greatly in tidally influenced waters (0.5 parts per thousand (ppt) to 35 ppt in the open ocean) and depend upon location within an estuary, the tides, and volume of freshwater inputs (VIMS website 2015). Tidal rivers and streams are typically associated with mudflats, swamps, and brackish and salt water wetlands (Anderson et al. 2013). Tidally influenced rivers occur east of the fall line in all eight coastal planning regions.

Blackwater streams and rivers are acidic, slow moving streams characterized by having a high level of tannins. Blackwater streams are confined to southeastern Virginia.

Cold water rivers and streams are characterized by the presence of trout and a water temperature that rarely exceeds 70 degrees Fahrenheit during the summer months (DGIF personal communication 2014). Cold water streams are generally found along the Blue Ridge and in the western mountains.

Non-tidal warm water rivers and streams encompass all rivers that are not cold water trout streams or tidally influenced. They represent the majority of streams and rivers within Virginia (Anderson et al. 2013). It is important to note that cold water rivers face challenges that the warm water aquatic systems do not experience. These additional threats are highlighted below.

Over 60 percent of Virginia's Action Plan species depend on one of these aquatic habitats. In reviewing their basic habitat needs, clean water and unsilted substrate were frequently identified as fundamental water quality requirements for many SGCN. Virginia's first Wildlife Action Plan indicated water quality can be impaired by a variety of factors and circumstances that allow or enhance the flow of sediment, chemicals, and nutrients into local watersheds. When input of these pollutants is negligible, water quality remains unimpaired; however, in cases when the flow of these materials is significant, water quality is often degraded to the point of threatening wildlife populations and human health.

Since the National Clean Water Act was implemented in the 1970s, substantial improvements have been made that curb point source pollution and water quality has dramatically improved. Non-point source pollution, however, continues to be a major threat to waterways in the state (Duke University et al. 2009). DEQ serves as the Commonwealth's lead agency for identifying and addressing nonpoint source pollution. DEQ staff test Virginia's waters to detect pollutants and identify threats to human health and safety. Water bodies that do not meet water quality standards are designated as being impaired. Water bodies are designated as impaired if they are found to:

- Exceed ambient water quality standards for aquatic life and human health;
- Require fishing restrictions or advisories;
- Require restrictions on the consumption of shellfish due to contamination;
- Show an over-enrichment of nutrients;
- Demonstrate significant declines in aquatic life biodiversity or populations; and/or

- Demonstrate sediment contamination at levels which violate water quality standards or threated aquatic live or human health (DEQ 2014).

Under section 303d of the Clean Water Act, many of the most severely impaired waters require a Total Maximum Daily Load (TMDL) be identified. The TMDL represents the total pollutant a water body can assimilate and still meet water quality standards. Once a TMDL has been established, DEQ staff, partners, and the public collaborate to create a Water Quality Improvement Plan that identifies and prioritizes actions needed to restore water quality.[2] This Action Plan recognizes the 325 watersheds with a TMDL and Water Quality Improvement Plans as conservation priorities for aquatic and riparian habitats (Figure 3.3).

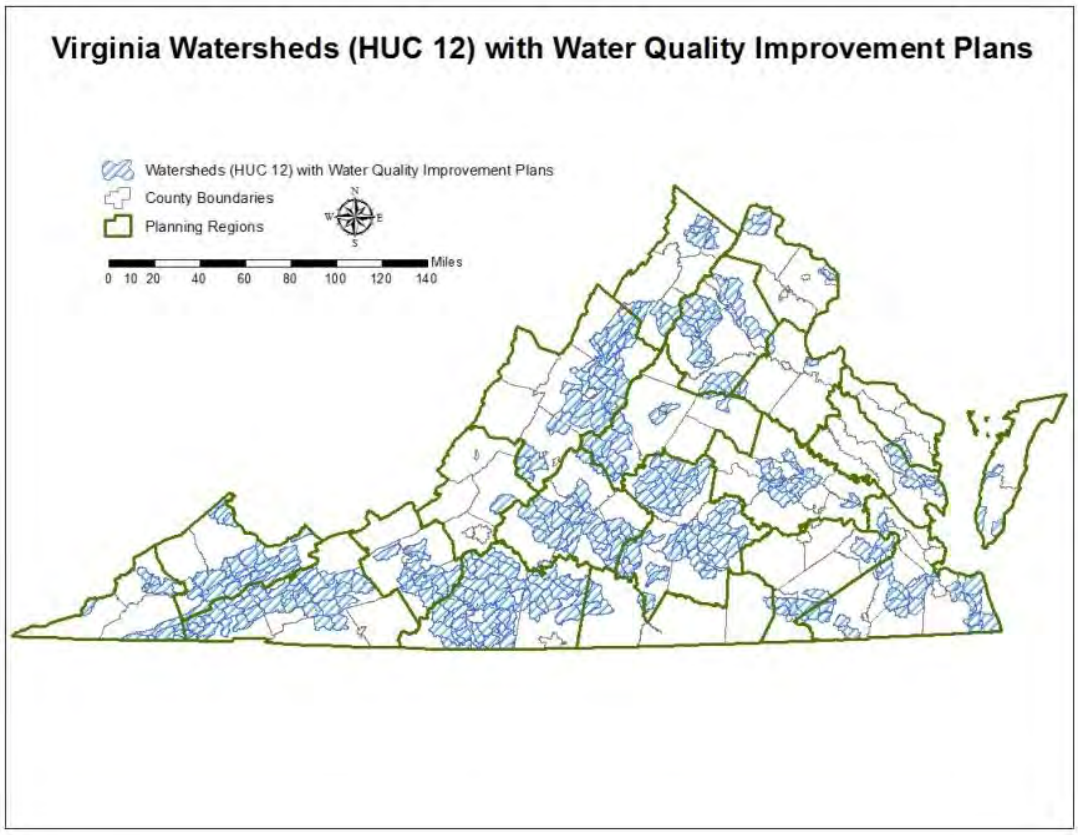

Figure 3.3. Virginia Watersheds with Water Quality Improvement Plans.

Some conservation partners have expressed concern about establishing a strong connection between the Action Plan and the TMDL program. These concerns warrant discussion.

1. The first concern involves the issue that some watersheds containing blackwater or swamp systems have naturally occurring lower levels of dissolved oxygen or low pH. Under TMDL guidelines, many of these watersheds could be classified as impaired even though the systems are healthy.

[2] A current list of available Water Quality Implementation Plans can be found on DEQ's website: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLImplementation/TMDLImplementationPlans.aspx

2. The second concern relates to how aquatic macroinvertebrates are used for biological monitoring under the TMDL system. Many macroinvertebrates are sensitive to pollutants, and monitoring changes in these invertebrate communities provides a reasonable measure of water quality. However, data are compiled at the taxonomic levels of genus or family, not at the species level (DEQ 2013). This approach may be appropriate to assess water quality for human health, but it does not provide specific enough data for identifying water impairment at a level that may be impactful on resident aquatic wildlife species. Aquatic wildlife can exhibit dramatically different tolerances to variations in stream flow or water chemistry, even if they are closely related. For example, the pheasantshell mussel (*Actinonaias pectorosa*) is in the taxonomic family Unionidae, is native to the Clinch River, and does not appear to be imperiled or in decline. Other members of this taxonomic family, such as the dromedary pearlymussel (*Dromus dromus*) and the elephantear (*Elliptio crassidens*) also occur in the Clinch River, but the dromedary pearlymussel is listed within the Wildlife Action Plan as a Tier I species (critical conservation need) and the elephantear is listed as a Tier IV species (moderate conservation need). By not evaluating rivers by the species they support, it is possible important wildlife conservation issues will not be identified.

3. There are instances where wildlife may be more sensitive to impairments than human communities or the invertebrates that are monitored to represent all wildlife. For example, the bridle shiner (*Notropis bifrenatus*) is a Tier I fish that hunts by sight. This shiner's ability to feed is impaired by even moderate levels of turbidity (Jenkins and Burkhead 1993). While a mild erosion issue would be unlikely to impact human communities and result in a TMDL, it could significantly impact the persistence of downstream bridle shiner populations.

4. Finally, impaired waters are described as stream segments. When monitoring for human health impacts, this level of precision is necessary to help the public avoid degraded areas. However, several aquatic biologists have noted that water quality impairments often reflect conditions throughout the entire watershed. This Action Plan is designed to address wildlife habitat, and focusing on efforts at the exact location of impairment may not be the most effective strategy for addressing water quality impacts upon habitat. Entire watersheds are prioritized for action as opposed to focusing only on impaired segments.

Despite these drawbacks, the TMDL system has a number of important strengths that will enhance Action Plan implementation. The TMDL program represents an ongoing, statewide, effort to measure and monitor water quality and make that information available to the public. Accessing and utilizing these data do not require human or financial investment on the part of DGIF or other members of the wildlife conservation community. Additionally, the Water Quality Improvement Plans were created to address water quality impairments, identify sources of those impairments, and describe actions needed to address those issues. While these plans are driven by human health concerns, the vast majority of TMDL impairments indicated within the improvement plans, such as eroding shorelines; degraded riparian vegetation; and the flow of fecal matter, fertilizers, and other harmful substances into rivers, also threaten wildlife populations. The Water Quality Improvement Plans, created with significant local collaboration and input, also articulate actions which, if implemented, address the documented impairments. Integrating these actions into the Action Plan allows practitioners to focus on conservation actions that have already been vetted through a formal public review process.

Finally, the issue of geographic specificity (stream reaches versus watersheds) can be addressed using GIS. The U.S. Geological Survey's National Hydrography Dataset has subdivided Virginia's landscape into

1,278 units known as HUC12 watersheds (Weary and Doctor 2014). Each HUC12 watershed ranges from 15 square miles to 65 square miles. DGIF used DEQ's map of impaired stream reaches to develop a map identifying the 325 HUC12 watersheds that contain impaired waters for which a TMDL plan has been written. Lacking a different system of similar rigor, Virginia's Wildlife Action Plan will utilize the Virginia TMDL framework to identify priority HUC12 watersheds for restoration and describe actions needed to improve aquatic habitat conditions.

An analysis of the existing Water Quality Improvement Plans indicates the most significant threats to water quality often relate to the management of riparian and upland areas. The most significant sources of water quality impairments include:

- Livestock allowed access to streams or insufficient controls to prevent animal waste from flowing into streams;
- Lack of vegetated riparian buffers;
- Lack of trees or other vegetation on highly erodible lands;
- Lack of cover crops on agricultural fields;
- Failing septic systems and "straight pipes" that deposit human waste into streams;
- Insufficient stormwater controls to prevent the flow of bacteria, phosphorus, and sediment into streams from areas with high levels of impervious surfaces; and
- Pet waste entering waterways.

Water Quality Improvement Plans also identified wildlife as a contributing source of fecal coliform impairments. Although no species were identified, it is assumed that deer, waterfowl, and aquatic mammals such as beaver, muskrat, and otter are the most likely contributors. At present, none of the existing plans discuss this issue in any detail or provide actions that can be taken to address this wildlife-related concern. Lacking additional guidance, it is assumed that the recommended list of conservation actions (see below) will help address at least some of the wildlife-related concerns. Broader, species-specific, conversations may be required.

A summary of each water quality improvement plan is provided as part of the aquatic habitat discussion within each Local Summary. The most frequently cited conservation actions include:

- Working with landowners to exclude livestock from streams;
- Establishing vegetated riparian buffers along waterways, especially along pastures and croplands to minimize soil erosion and the overland flow of fertilizers, pesticides, herbicides, and fecal material into streams;
- Repairing, stabilizing, and restoring stream banks to minimize erosion;
- Revegetating highly erodible areas and providing sediment retention/control to prevent sediment from flowing into streams;
- Maintaining cover crops on cropland to minimize the flow of sediment, fertilizers, pesticides, and herbicides into streams when fields are not being used to produce other crops;
- Repairing or replacing failing septic systems and eliminating "straight pipes" depositing human waste into streams;
- Maintaining and expanding systems to manage storm water runoff to prevent bacteria, phosphorous, and sediment from flowing into streams from areas of impervious surface;
- As needed, working with pet owners to implement a program to prevent pet waste from flowing into streams; and

- As needed, working to enhance sewage pump out sites for boats.

Cold Water Streams

As indicated previously, cold water streams include water bodies that do not exceed 70 degrees Fahrenheit for extended periods (DGIF personal communication 2014). Brook trout is an Action Plan species that relies upon these cold water habitats and will be used to represent other similar cold water species. In addition to many of the issues identified for other rivers, cold water streams may also be degraded by thermal impairments and acid deposition.

Low water temperatures are maintained in cold water streams through stream shading and cold groundwater inputs. If trees are removed from these riparian areas or if the flow of groundwater into streams is disrupted, water temperatures can become too warm to support brook trout and other cold water species. The 2011 Eastern Brook Trout Joint Venture Conservation Strategy stresses the value of healthy riparian buffers and the utility of working with public and private landowners to restore riparian forests to improve degraded habitats (Eastern Brook Trout Joint Venture 2011). Working to maintain forest cover and minimizing the amount of impervious surface within a watershed will help maintain the infiltration of water into the groundwater system.

Many of Virginia's cold water streams are impacted by acidic precipitation. When acidic rain enters a stream, water chemistry is altered, which may eliminate or significantly degrade brook trout habitats. As indicated by the Eastern Brook Trout Joint Ventures Conservation Strategy adding lime (coarse limestone sand) to a stream can temporarily mitigate the impact of acid precipitation. While it is not a permanent solution, DGIF biologists have employed this technique to maintain specific brook trout populations (Eastern Brook Trout Joint Venture 2011). DGIF will continue collaborating with private, state, and federal partners to implement efforts to improve the condition of cold water habitats.

High Integrity Watersheds

As indicated previously (see Habitat Focus), the Virginia Watershed Integrity Model considered a variety of biotic, abiotic, and human use factors to consider the quality of Virginia's watersheds and identify high quality drainages. In addition to restoring the quality of impaired waters, it is important that Virginia's conservation community work to maintain the health of Virginia's High Integrity watersheds (Figure 3.4). DGIF will continue collaborating with private, state, and federal partners to implement efforts to maintain or improve the quality of water within these watersheds. Information on high priority watersheds have been provided within each Local Summary and these data will be updated as new information becomes available.

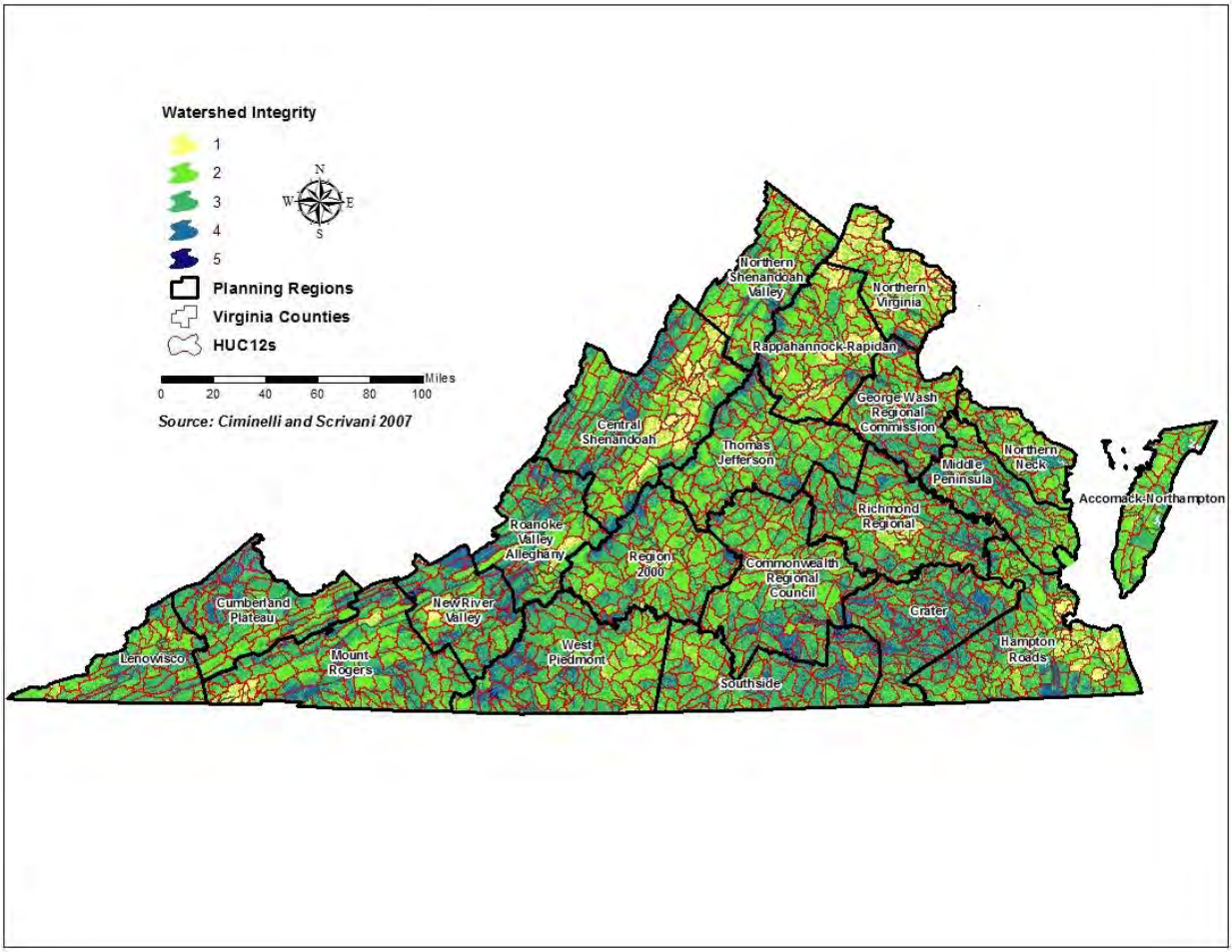

Figure 3.4. Virginia Watershed Integrity Model (Ciminelli and Scrivani 2007).

Aquatic Connectivity

A lack of aquatic connectivity has been identified as a significant threat to the conservation of aquatic SGCN (Martin and Apse 2013) (DGIF 1991) (Martin et al. 2014). DGIF implements a Fish Passage program that works to enhance aquatic connectivity by either removing or modifying dams and other impediments so that fish and other aquatic species may move more freely throughout individual watersheds. This program has been funded with State Wildlife Grants and other resources. DGIF intends to continue using State Wildlife Grants and other resources to enhance the connectivity of Virginia's rivers. Likewise, these resources may be used to document the effectiveness of these restoration efforts by monitoring changes in habitats, water quality, and aquatic wildlife communities after the impairment has been removed or modified. It is DGIF's intent to use the Chesapeake Bay Fish Prioritization Tool, the Southeast Aquatic Connectivity Assessment Tool, landowner willingness, and other criteria to identify priority areas (Figure 3.5) for work during DGIF's annual budgeting and work planning process.

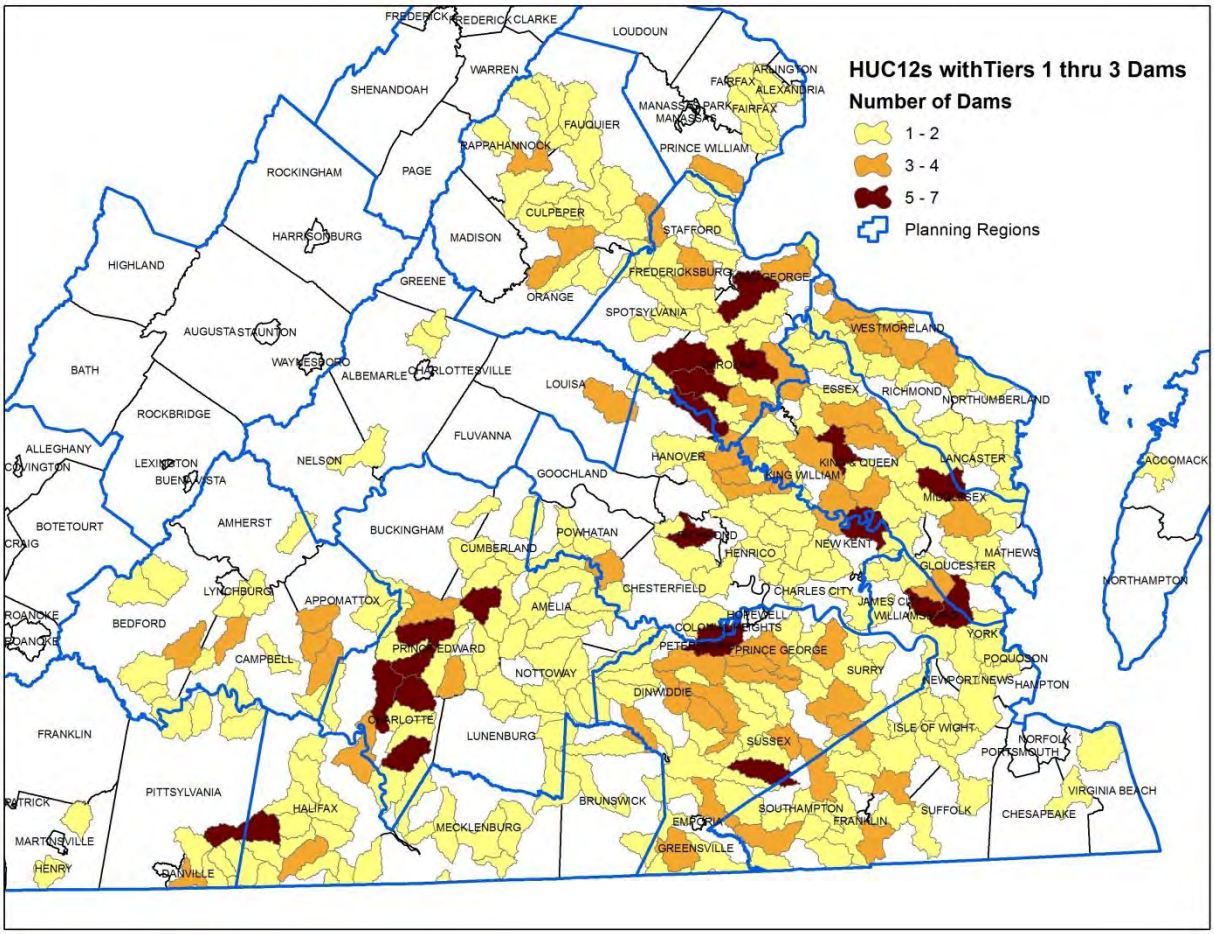

Figure 3.5. Watersheds in the Chesapeake and Albemarle Drainages Identified as Priorities for Improving Aquatic Connectivity (Martin and Apse 2013).

Open Habitats

For this Action Plan, DGIF uses the term "open habitats" to represent an assortment of communities that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have identified several types of open habitats that are important for Action Plan species. These habitats include glades and barrens, savannas, and post-agricultural (old field) habitats. They also can include openings or clearings which are primarily herbaceous fields within woodlands. These open habitats are important to a variety of SGCN, including northern bobwhite quail, golden-winged warblers, the seven SGCN bumble bees, the monarch butterfly, and other native pollinators. Two issues threaten the existence and quality of Virginia's open habitats. The first is development. Open habitats can be easily converted to human uses. The second involve the lack of natural disturbance regimes that hinder natural successional processes. Given the Commonwealth's climate, latitude, and soils, Virginia's landscape can support a diversity of forests. During precolonial times, natural and anthropogenic fires, floods, hurricanes, ice storms, and insect outbreaks would create and maintain large areas of open habitat within the larger forested landscape (Oehler et al. 2006). In modern times, many of these issues are controlled; allowing trees to

grow and create a canopy that eliminates the open character of these habitats. Open habitats must be managed using fire or other tools that preserve their openness.

Glades and Barrens

Glades and barrens are naturally occurring open habitats that are characterized by shallow soils and rocky substrates. These habitats generally have a grassy layer with some low shrubs and herbs and scattered trees (often less than 40 percent of tree cover) as well as patches of moss and lichen (Anderson et al. 2013; Fleming et al. 2013; Comer 2003). Open rocky areas can also be predominant (Comer 2003). Glade and barren habitats are found in 12 planning regions in the more central and western portions of the state.

Glades and barrens represent distinct botanical communities (C. Ludwig, VA Dept. of Conservation and Recreation, Natural Heritage Program, personal communication 2015). Because of their small size, prolonged disturbances can eliminate these botanical communities, and because these habitats tend to be geographically isolated, once a community is eliminated, it may be impossible for many species to reoccupy a site without human intervention. Historic threats to these systems have included intense quarrying, which has resulted in loss of many habitat patches and the fragmentation of surrounding areas (Anderson et al. 2013). Some glades and barrens occur within agricultural lands, which also can lead to fragmentation and degradation of the habitat from overgrazing. The introduction of non-native and invasive species threatens native species endemic to these habitats, and recreational activities within these habitats often results in trampled vegetation (USFS 2014).

In order to conserve glade and barren habitats, the conservation community can work collaboratively with public and private landowners to conserve these areas either through easement, acquisition, or agreement. As agencies consider land acquisitions, they should consider giving greater priority to properties that contain current or historic glade and barren habitats. Where these habitats have been conserved, important management actions include prescribed burns and managing wildfires, monitoring and controlling non-native species, and managing the recreational use of areas to prevent the trampling of rare plant communities (USFS 2014).

Savannas

Savannas are unique communities dominated by large mature trees, open canopies, low densities of young trees, and abundant grass and forb ground covers. A few examples of hardwood savannas occur on military installations in northern and eastern Virginia and small acreages of longleaf pine savanna occur on conserved lands in southeast Virginia. Historically, savannas would have been maintained by wildfires or anthropogenic fires that would have removed shrubs and young trees while leaving mature trees intact. Today, savannas are maintained by prescribed fire. While existing savanna habitats can be maintained with management, new savannas are not likely to be created through natural processes.

While savannas offer unique habitat conditions that can support an assortment of species, they have limited economic value. As such, few private landowners can afford to manage their properties to include a savanna habitat. Historic fire suppression on conserved lands has allowed diverse mixed forest communities to exist in areas that were once savanna communities. The only viable means of creating and maintaining savannas involves working with public and private landowners to conserve areas through acquisition, easement, or agreement and managing those areas with fire to preserve mature trees while eliminating younger aged trees and shrubs. To maximize the benefit of these efforts,

Virginia's conservation community should focus such efforts on areas either adjacent to, or in close proximity to, existing savanna habitats.

Post Agricultural (Old Field) Habitats

Post-agricultural habitats include fields, orchards, or pastures that are taken out of production and allowed to go fallow. Two basic circumstances can result in the creation of a post-agricultural habitat. First, changing markets or other circumstances create a situation where a property is economically unviable. In other instances, a conservation-minded landowner may choose to manage portions of their property as habitat for some suite of wildlife. Although it can be incredibly useful from a wildlife management perspective, very little post-agricultural habitat exists in Virginia. Relatively high crop prices and the potential for a developing biofuels industry allow many agricultural properties to remain economically viable. In many cases, despite a desire to provide habitat, many landowners lack the financial means needed to bring portions of their property out of production. Likewise, some agricultural landowners may be influenced by a persistent cultural attitude that fallow land represents a management failure by the owner.

Small acreages of post-agricultural lands can be found throughout Virginia, and these can be managed to provide a diversity of wildlife habitats. Unfortunately, because these lands may be valuable for agricultural purposes, they tend to be very expensive to acquire. Despite this, the diversity of management opportunities makes these areas desirable for wildlife conservation. Agriculturally viable soils are one factor considered by the DGIF when evaluating a parcel for acquisition, because healthy soils facilitate establishment of beneficial habitats. When retired agricultural lands have been conserved, their unique habitat conditions tend to persist for 10 to 20 years before maturing into a different (likely a forested or shrub) habitat type. Working with willing private landowners to conserve these properties through acquisition, easement, or agreement will provide a means of bringing these properties into a conserved state.

One of the primary programs for conserving and restoring open habitats within Virginia is Virginia's Quail Recovery Initiative (QRI), which is a robust multi-partner effort. While the QRI uses quail as a focal species, quail compatible habitats are known to support a suite of other SGCN including field sparrows, eastern towhees, brown thrashers, prairie warblers, seven bumble bee species, and the monarch butterfly. QRI efforts are directed towards six focus areas based upon Soil and Water Conservation Districts (SWCD). The six focus areas include:

- Chowan Basin SWCD – covers Sussex, Southampton, and Greenville Counties;
- Halifax SWCD – covers Halifax County;
- Big Walker SWCD – covers Bland and Wythe Counties;
- Headwaters SWCD – covers Augusta County;
- Culpepper SWCD – covers Green, Orange, Madison, Culpepper, and Rappahannock Counties; and
- Three Rivers SWCD – covers Essex, King and Queen, and King William Counties

These six districts will be recognized as priorities for open habitat conservation within the Action Plan. As the QRI is updated or adapted, new priorities will be incorporated into the online version of the Action Plan.

Forest Habitats

Virginia's forests cover approximately 62 percent of Virginia (15.8 million acres), of which 15.3 million acres are available for commercial harvest, and 500,000 acres are reserved forested lands (or lands not in production) (DOF 2010). More than 12.9 million acres (over 80 percent) of forests in the state are privately owned, while approximately 16 percent of the forested area is publicly owned (owned by federal, state, or local agencies) (DOF 2010). The USFS manages the largest portion of public forested lands, 1.6 million acres, while Virginia's DOF manages 65,000 acres in 20 different state forests (DOF 2010). There are two main types of forests described within this Action Plan – mixed hardwood/ conifer and spruce fir. Mixed hardwood and conifer forests can host a range of oak, hickory, and pine species, including pitch pine (*Pinus rigida*), Table Mountain pine (*P. pungens*), shortleaf pine, white pine, white oaks, southern red oak, northern red oak, chestnut oak, and live oak (Comer et al. 2003). Other tree species that may be found in these forests can include red-cedar, American beech, sugar maple, American basswood, and yellow birch, among others (Comer et al. 2003).

Mixed Hardwood/ Conifer Forests Habitats

Mixed hardwood and conifer forests are found across the state and in all 21 Planning Regions. They make up a large percentage of existing forests. However, threats and conservation actions can vary slightly depending on the location. Threats and conservation actions are described below for mixed hardwood/conifer forests west of the Piedmont and mixed hardwood/conifer forests in the Piedmont and Coastal Plain. Additionally, there are five specific types of mixed hardwood and conifer forests in the state that face varying sets of threats and actions as well. These five forest types (young forests, North Atlantic coastal plain maritime forest, Central Atlantic coastal plain maritime forest, Southern Atlantic coastal plain upland longleaf pine woodland, and Southern Appalachian low elevation pine forest) will be described in more detail individually below.

The habitat value of mixed hardwood and conifer forests west of the Piedmont is limited by a lack of oak and pine regeneration (USFS 2014). This issue is of most concern on publicly owned forests and is of minimal concern on private forests. Information from the Virginia Forest Inventory Assessment indicates less than 5 percent of Virginia's mountain forests are younger than 10 years (DOF 2010). The lack of any regeneration was identified by many Action Plan contributors as being the single greatest challenge for wildlife conservation in Virginia's western mixed hardwood/ conifer forests. While mature forest habitats provide benefits to an assortment of aquatic and terrestrial species, the conspicuous lack of young forest habitats severely limits opportunities for open habitat species such as the northern bobwhite quail, golden-winged warbler, field sparrows, eastern towhees, brown thrashers, prairie warblers, chestnut sided warbler, yellow breasted chat, ruffed grouse, American woodcock, and bumble bee species.

Many of these habitats on federal lands are impacted by destructive insect species (USFS 2014). Gypsy moth (*Lymantris dispar dispar*) caterpillars and emerald ash borer (*Agrilus planipennis*) larva are particularly destructive to oak and ash, respectively. Various pine bark beetle species (Family Scolytidae) infest pine species. In each of these cases, insect activity can either kill mature trees or stress infested trees to the point they become vulnerable to other pests and diseases (Virginia Tech 2008). Impacts from insects can vary from year to year with the greatest effects occurring during outbreak years when large insect populations can affect large numbers of trees over a wide area.

Finally, conservation partners identified acid precipitation and climate change as threats that degrade these forested habitats at higher elevations (i.e., above 3000 feet). The USEPA indicates that acid precipitation can stress trees either by enhancing the leaching of soil nutrients or by dissolving rock and releasing toxic elements such as aluminum into the soil (EPA website 2012). Trees at higher elevations can also be affected by acidic clouds and fog that damage leaves and needles. While acidic precipitation may not immediately kill trees, the additional stress often makes trees susceptible to other issues such as diseases and invasive species. At the current time, no viable on-the-ground management strategies have been identified to address acid precipitation.

In terms of conservation actions, the restoration of successional processes was identified by conservation partners as the most important effort that could be undertaken within the mixed hardwood/ conifer forests on public lands in the western portions of Virginia. Such efforts would provide a greater diversity of habitats capable of supporting dozens of SGCN. In 2014, the USFS determined the desired ecological condition for broad groups of oak forest types in the George Washington National Forest would include a mosaic of compositional and structural diversity of patches, articulated in various age classes and canopy conditions (Tables 3.3 and 3.4) (USFS 2014). These desired conditions could be achieved and maintained through natural disturbances, timber harvest and the use of prescribed fire.

Table 3.3. Desired Ecological Condition of Oak Forest by Age Class (USFS 2014).

Structure	Open	Mid-Successional Closed Canopy	Mid- Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	12	7	10	57	14
Age	0-15	16-69	16-69	70+	70+

Table 3.4. Desired Ecological Condition of Pine Forest by Age Class (USFS 2014).

Structure	Early	Mid-Successional Closed Canopy	Mid-Successional Open Canopy	Late Successional Open Canopy	Late Successional Closed Canopy
% of ecological system	13	3	25	54	5
Age	0-15	16-70	16-70	71+	71+

Other important conservation actions include working with industry and localities to create development plans that avoid priority forest patches as well as maintaining robust forest buffers along rivers, wetlands, and unique botanical communities such as glades and barrens.

Issues impacting hardwood and conifer forests in the eastern portions of Virginia are distinctly different from the issues impacting similar forests in the western portions of the Commonwealth. For example, forests in the eastern portion of Virginia have a much greater diversity of age structures (DGIF personal communication 2014). They also tend to be more highly fragmented and at greater risk of being converted to other land uses (Anderson et al. 2013). Action Plan partners also noted that these forests are affected by a greater number of invasive species than are found in the west portions of Virginia.

The loss or fragmentation of hardwood and conifer stands was identified by conservation partners as being the single greatest threat to this habitat in the eastern portions of Virginia. In many cases, as with

urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other cases, such as conversion to pine plantations, one specific forest habitat is lost, but these lands can be managed as open habitats that support a diversity of other landowner goals, wildlife species, and recreational opportunities. If BMPs established by the Virginia DOF are followed, impacts to waterways and adjoining properties may be prevented or mitigated (DOF 2011).

Actions for conserving hardwood and conifer forests in Virginia's piedmont and coastal plain include working to conserve, either through acquisition, easement, cooperative management, or incentives large intact forest patches capable of supporting a variety of SGCN. Initial priorities for conservation include patches of hardwood and conifer forests adjacent to conserved lands (wildlife management areas, state parks, national parks, municipal parks, Heritage sites, national wildlife refuges, etc.) and forests buffering rivers, streams, wetlands, and unique botanical communities. These networks of secured lands could be enhanced with new areas to achieve larger, more functional forest cores that are buffered and connected. TNC's Resilient Sites for Terrestrial Conservation analysis can be used to help identify and prioritize protection and conservation of sites that would contribute to a resilient network of forests as well as provide habitat for SGCN (Anderson et al. 2012).

Young Forests

The term "young forest" is loosely defined and refers to areas dominated by woody seedlings and saplings (Oehler et al. 2006). The term can be applied to any forest type. Previously, young forests have been referred to as a form of early successional habitat. Virginia's forests, especially on public lands in the western portions of the state, lack significant areas of young forests. Given that young forest habitats support a multitude of Action Plan species, DGIF is actively involved with the Wildlife Management Institute's Young Forest Initiative.

Prior to European contact, a variety of natural and anthropogenic disturbance factors resulted in some portion of a forested landscape in North America being made up of younger forest age classes (Oehler et al. 2006). Disturbance factors included floods, hurricanes, ice storms, insect outbreaks, wild fires, and human induced fires. During later periods, logging and land clearing also produced significant amounts of young forest habitat (Oehler et al. 2006). During the last century, with flood control and fire suppression, many of the natural forces that create young forest have been minimized or altered. Likewise, in many parts of the country, logging has become less economically viable – especially on public lands. These altered natural disturbance regimes have resulted in a significant decline of young forests.

Areas can retain young forest conditions for up to 50 years post disturbance, depending upon the location, soil fertility, tree species, and other variables (Oehler et al. 2006). The Wildlife Management Institute, however, indicates young forest conditions are more likely to remain for 15 to 20 years before the botanical community transitions into a mature forest type. Although patches young forest habitats are found throughout Virginia, due to their transient nature, these habitats are profoundly difficult to represent geographically. Young forests are most prominent in the Coastal Plain and southern Piedmont. Of the young forests in the Coastal Plain, many have been planted as pine plantations. These plantations are most likely to occur on private lands (DOF personal communication 2014).

Timber harvest and prescribed fire are the two primary means of creating a young forest habitat from a mature forest habitat (Oehler et al. 2006). The effectiveness of each process will be influenced a variety of factors, including:

- What types of wildlife the manager is interested in conserving?
- What are the current and past conditions of the property (soil type, slope, land use, etc.) that will influence the ability to achieve management goals?
- Does the land have the potential or inherent ability to produce the types of habitats needed for the target wildlife species?
- How large is the property?
- How does the property fit into the overall landscape perspective?
- What management actions are needed to achieve the desired young forest conditions?

Within the Technical Manual, *Virginia's Forestry Best Management Practices for Water Quality* (2011), DOF has established BMPs to help land owners and property managers plan and execute both timber cuts and prescribed burns in ways that achieve management goals and prevent undesirable impacts for young forests (DOF 2011).

North Atlantic Coastal Plain Maritime Forest

Patches of North Atlantic Coastal Plain Maritime Forest are found along the shores of the eastern portion of Virginia, north of the James River and along Virginia's Eastern Shore barrier islands. This forested habitat may be adjacent to or mixed within dune, swale, or beach habitats. Because of its proximity to the coastline, this forest type typically has few tree species and trees are often stunted. A dense vine layer may also be present (Anderson et al. 2013). Depending on location and exposure to maritime forces, tree species vary but can include pines (e.g., pitch, Virginia, loblolly, and shortleaf pine) and oaks (e.g., scarlet, black, scrub, and post) and eastern red cedar, black cherry, American holly, sassafras, and red maple. Vegetation and habitat is affected by salt spray, wind, sand and dune deposition, and sometimes inundation (Anderson et al. 2013).

There is some disagreement regarding the amount of this habitat that remains in Virginia. In 2007, the Virginia Institute of Marine Science (VIMS) completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). Their review of satellite imagery and field surveys indicated that 1,389 acres of this habitat remains, and these communities are only found on the Eastern Shore. This report also indicated over 88 percent of the remaining north Atlantic coastal plain maritime forests occur on conserved lands. By contrast, Anderson et al. indicated Virginia possesses over 14,000 acres along both the eastern and western shores of the Chesapeake Bay (2013). Anderson et al. estimates that 15.6 percent of this habitat occurs on conserved lands (2013). The primary distinction between the two models appears to involve the classification of appropriate soils, the inclusion of wetlands, and distance from a coastal shoreline. The VIMS model included a significant ground survey, specifically targeting maritime forests while the Anderson et al. model was evaluated more generally (2013).

Berman and Berquist (2007) indicate climate change, including sea-level rise and projected increasing storm intensity and frequency, and development are the principal issues threatening these remaining patches of north Atlantic coastal plain maritime forests. When practicable, efforts to reconcile the two habitat maps would help determine if additional acres of north Atlantic coastal plain maritime forest

exists. If such habitats are found, it would be advantageous for agencies to work with willing landowners to bring those habitat patches into conservation through acquisition, easement, incentive, or agreement. Given that the vast majority of known acreage has already been conserved, the near-term threat of extirpation is likely slight.

Central Atlantic Coastal Plain Maritime Forest

This forest type includes a mosaic of forests and shrublands on Atlantic Coast barrier islands and similar coastal strands from Virginia Beach to central South Carolina. Typically less than two miles from the ocean, these maritime forests are influenced by salt spray, extreme disturbance events, and the distinctive climate of the immediate coast. Salt-tolerant evergreen tree species are most common, particularly live oak, wax-myrtle, and loblolly pine. Embedded freshwater depressional wetlands are typically dominated by shrubs or small trees, such as red maple, swamp tupelo, stiff dogwood, or swamp bay (Anderson et al. 2013).

There is also some disagreement regarding the amount of this habitat that remains in Virginia. In 2007, the Virginia Institute of Marine Science (VIMS) completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). Their review of satellite imagery and field surveys indicated that 2,704 acres of this habitat remains within the borders of Virginia Beach. This report also indicated all of the remaining central Atlantic coastal plain maritime forests occur on conserved lands. By contrast, TNC indicates Virginia possesses almost 6,300 acres (2013). Anderson et al. (2013) estimate that over 88 percent of this habitat occurs on conserved lands. The primary distinction between the two models appears to involve the classification of appropriate soils, the inclusion of wetlands, and distance from a coastal shoreline. The VIMS model included a significant ground survey, specifically targeting maritime forests while the Anderson et al. model was evaluated more generally.

Berman and Berquist (2007) indicate climate change, including sea-level rise and the threat of increasing storm intensity and frequency, and development are the principal issues threatening these remaining patches of central Atlantic coastal plain maritime forests. When practicable, efforts to reconcile the two habitat maps would help determine if another 3,600 acres of central Atlantic maritime forest exists. If such habitats are found, it would be advantageous for agencies to work with willing landowners to bring those habitat patches into conservation through acquisition, easement, incentive, or agreement. Other than working to support the management and conservation actions at Back Bay National Wildlife Refuge, False Cape State Park, and First Landing State Park, additional conservation actions do not appear to be warranted at this time.

Southern Atlantic Coastal Plain Upland Longleaf Pine Woodland

Southern Atlantic coastal plain upland longleaf pine woodland is found in a few small patches in southeastern Virginia within the coastal plain on sites characterized by sandy soils. Specific forest composition varies based upon management. In areas that experience infrequent fires, oaks (e.g., southern red, post, blackjack, turkey) dominate, while areas with more frequent fires are dominated by longleaf pines. The understory may be made up of scrub oaks or heath shrub. This forest type was once more prevalent in Virginia, but with clearing, agricultural conversion to other species and fire exclusion over the decades, longleaf pine has largely been replaced by loblolly pine (Anderson et al. 2013).

Anderson et al. (2013) indicate fewer than 600 acres of this forest type occur in Virginia. Of these, 28 percent occur on conserved lands. Although longleaf pine has a variety of economic values, many private landowners find loblolly pines to be a more viable economic alternative (DOF 2007). In the near term, priorities for conserving and restoring longleaf pine woodlands should focus on working with willing landowners to conserve the remaining stands of southern Atlantic coastal plain upland longleaf pine woodlands either through acquisition, easement, or agreement and continuing efforts to restore longleaf pines to forest communities on conserved lands. Opportunities may also exist to collaborate with private landowners to help restore longleaf pines to forest communities through easements, incentives, or cooperative agreements. Priority needs will focus on private lands that are either adjacent, or are in close proximity to, existing longleaf pine stands and pine savannas.

Southern Appalachian Low Elevation Pine Forest

This habitat is described as an open forest or woodland of acidic substrates at low elevations in southwest Virginia (Anderson et al. 2013). Vegetation is dominated by Virginia pine and shortleaf pine, occasionally with pitch pine. Hardwoods may be abundant, especially dry-site oaks such as southern red oak, chestnut oak, and scarlet oak, but also pignut hickory, red maple, and others. A heath shrub layer may be well developed. Herbs are usually sparse, though communities of this system may have been grassy when fires were more frequent. The ecological character and natural distribution of this system has been obscured over the years by the loss of shortleaf pine due to human settlement, universal logging, pine beetle outbreaks, and fire suppression (Anderson et al. 2013). Despite the forest type's tolerance for a wide range of ecological conditions and its economic viability, the Virginia Cooperative Extension indicates a decline of almost 90 percent of shortleaf acreage since 1940 (Gagnon and Johnson 2009).

Given the dramatic decline of shortleaf pine in recent decades, there is a growing realization that shortleaf pine restoration is warranted. Such restoration efforts could potentially benefit a number of SGCN including northern bobwhite and red cockaded woodpecker (Burns et al. 1990). Working to restore or enhance shortleaf pine within existing patches of southern Appalachian low elevation pine forests as well as new areas would be beneficial. Efforts could occur on agency lands and in coordination with interested private land owners. Virginia Tech Cooperative Extension indicates growing and mature shortleaf pine benefit from thinning strategies (Gagnon and Johnson 2009). When working to establish new stands of shortleaf pine, especially if no shortleaf seed bank is expected to exist, the Virginia Tech Cooperative Extension recommends clear cutting and implementing an artificial regeneration technique such as direct seeding or planting seedlings (Gagnon and Johnson 2009).

Spruce-Fir Forest Habitats

Spruce-fir forests are found in western Virginia at elevations of 3,200 to 5,000 feet on high peaks that are cold and windy. Red spruce is predominant, along with Frasier fir in southwest Virginia and balsam fir in the northwest of the state (Anderson et al. 2013). Some significant areas of this forest type remain, but much of it has been lost and is now grass-shrub-hardwood scrub (Anderson et al. 2013). Spruce fir forests are typically found in older aged stands with a relatively high level of connectedness, likely due to the fact they are found higher upslope in areas with less development. Many of Virginia's spruce-fir forests were logged during the early 20th century. Anthropogenic fires, fueled by logging slash, converted large areas of former spruce-fir forest into a grass-shrub-hardwood habitat, and spruce-fir forests have not recovered to conifer dominance after 90 years (Anderson et al. 2013).

Virginia's remaining spruce-fir forests are impacted by a variety of threats. Invasive species such as the balsam woolly adelgid, the hemlock woolly adelgid, and the eastern spruce beetle cause considerable damage and mortality to Fraser firs, balsam firs, and red spruce throughout the southern and central Appalachians (Burns et al. 1990). Acid precipitation also has been a contributing factor to the decline of spruce-fir forests in the eastern United States by damaging plant needles and altering soil chemistry (EPA website 2014). Collectively, these impacts can make trees more susceptible to disease and pest issues. Finally, recent climate models indicate that under current greenhouse gas emission scenarios, Virginia's climate could become unsuitable for red spruce by mid-century (Klopfer et al. 2012).

Efforts to conserve spruce-fir forests should focus on several actions. First, maintaining conditions that will be favorable to growth and expansion in existing stands will be important (USFS 2014). Efforts to restore red spruce could be focused on areas that have existing populations of Norway spruce and red pine (USFS 2014). Planting red spruce seedlings should also be part of any restoration effort (USFS 2014). Working with landowners, forestry groups, planning district commissions, and others to ensure development in high elevation areas does not destroy or fragment these rare forest communities will be necessary. Robust review and commenting on any residential/ commercial development and energy development proposals from interested agencies and other groups could also help ensure conservation measures are taken or development is guided towards less sensitive areas.

Subterranean Habitats

Virginia has two basic categories of subterranean habitats – karst and groundwater. Karst habitats are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas are often underlain by limestone or dolostone bedrock and characterized as landscapes with underground drainage networks (Figure 3.6). These areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Maps of areas with karst features are provided within the local summaries. There are over 4,300 known caves in the state (DCR 2008). Karst systems provide important habitats for many SGCN invertebrates as well as bats. Karst habitats are primarily located in eight of the western planning regions; however, some smaller karst systems can be found in the Piedmont and Coastal Plain (DCR website 2008).

Several subterranean SGCN invertebrates occur in nonkarst aquifers. These species are rarely encountered but have been collected from wells and springs in the northern portions of the Piedmont and Coastal Plain (W. Orndorff and C. Hobson, Va Dept. of Conservation and Recreation, Natural Heritage, personal communication 2015).

These subterranean systems are some of the least understood habitats represented within Virginia's Action Plan. While these systems are distinct and each supports a unique set of fauna, these subterranean habitats are often impacted by similar threats and would benefit from similar conservation actions. For example, these subterranean habitats can only be sustained with clean and abundant water resources flowing through them. If water quality or water quantity is impaired, habitat suitability diminishes. Most water-related threats originate from surface land use, including pollution allowed to infiltrate into groundwater systems, over withdrawal of groundwater for human uses, dumping of garbage and other debris into sinkholes, and impervious surfaces that direct water away from groundwater recharge areas (DCR 2008).

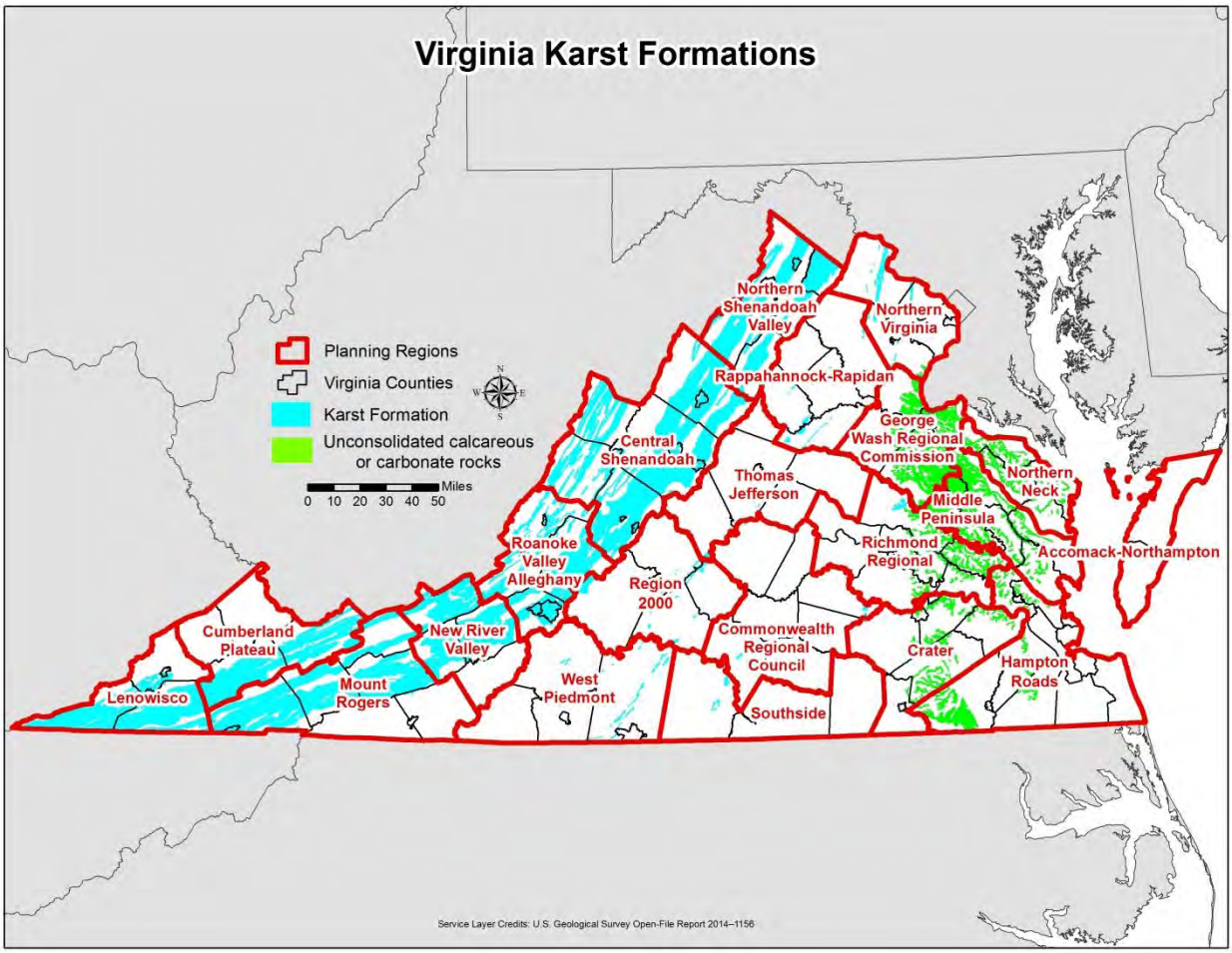

Figure 3.6. Virginia's Karst Formations (Weary and Doctor 2014).

Actions to conserve these habitats are limited by a lack of data describing how water enters and moves through the groundwater systems. Being underground limits the opportunities for direct observation, and access to wells and springs may be limited by private landowners. As such, it is impossible to provide specific guidance or prioritize specific areas for additional conservation. Until such data are available, general guidelines include maintaining as much vegetative cover as possible in areas that overlay karst topography or aquifers, establishing vegetative buffers around springs and sinkholes, and working to limit opportunities for surface pollution to contaminate springs and seeps.

Statewide Threats to Multiple Habitats

Invasive Species

In addition to the impacts invasive species have on wetland habitats (see above), the Virginia Invasive Species Management Plan identifies several species that have a profound impact on terrestrial ecosystems. Invasive species such as the gypsy moth, ramorum blight, sirex wood wasp, and emerald ash borer are known to kill large numbers of trees and alter forest health and composition. Invasive plant species, such as tree of heaven, privet, and Japanese stilt grass are aggressive colonizers, taking advantage of degraded natural habitats, outcompeting native species, and significantly altering the character and quality of local habitats. Virginia's Natural Heritage Program has identified over 90

invasive plant species. Additionally, invasive wildlife species such as fire ants and feral hogs are known to degrade the quality of native habitats, damage crops, kill native wildlife, and, in some cases, be dangerous to humans.

Unfortunately, there are insufficient human and financial resources in Virginia to eradicate all known invasive species. Virginia's Invasive Species Management Plan identifies seven goals (each with multiple strategies) for addressing invasive species issues in Virginia (VISWG 2012). These goals include:

- *Coordinate state, federal, and stakeholder prevention and management of invasive species infestations;*
- *Prevent known and potential invasive species from entering the state through detecting and interrupting all unauthorized species introductions;*
- *Promote and enhance professional and volunteer invasive species early detection through education and reporting tools;*
- *Enhance rapid response capability to implement eradication or containment procedures for target species through planning;*
- *Provide control of priority invasive species through containment, abatement, and other management strategies—including habitat restoration and use of native species—to minimize environmental and economic impacts;*
- *Support or conduct research, monitoring, and risk assessment necessary to assess, prioritize, and control invasive species; and*
- *Provide current information on invasive species, their negative impacts to environmental and economic resources, and methods of prevention and control to the general public, environmental nongovernmental organization, special interest groups and K-12 science teachers (VISWG 2012).*

Climate Change Impacts

Based on numerous regional and state specific research and reports, it is likely that Virginia's climate will change and have impacts on the state's fish, wildlife, and habitats. Climate change will likely affect these resources directly, but more importantly, climate change is expected to exacerbate existing threats such as water quality and habitat degradation. Although many climate impacts represent longer-term threats, some, with more immediate implications, such as more frequent storm events and heat waves/ higher temperatures, are already occurring. Understanding the impacts and what those changes may mean for species and habitats within Virginia is important to ensure conservation actions are robust and effective now and into the future. This section provides a general overview of likely climate impacts in Virginia, what those changing conditions may mean for species and habitats, and the types of climate-smart conservation actions will help address climate change impacts within the state.

All available climate models project the Northeast and Virginia will experience a substantial increase in temperature by the end of the century. A recent study focusing on the Northeast and Midwest notes that temperatures within the region may increase from 4°C to 5 °C by mid-century (Staudinger et al. 2015). The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Virginia's 2008 Climate Action Plan projects that average temperatures in Virginia will increase by 3.1°C (5.6°F) by the end of the century (Governor's Commission on Climate Change, 2008). Although there are a range of projections, there is consensus that temperatures will increase. It

is likely that heat waves and more extreme temperatures will also become more prevalent (Staudinger et al. 2015).

Models also project that precipitation yearly averages will likely increase in the Northeast due to more intense rainfall events. However, precipitation events will likely become less frequent but last longer (Staudinger et al. 2015). In turn, this may mean more dry spells, and with projections showing increases in precipitation more likely to occur in winter and spring months. As a result, this may mean more droughts in the summer months as well as more flooding, during the more intense events (Staudinger et al. 2015; Pyke et al. 2008). It is important to note that precipitation projections are less robust than those for temperature due to the difficulty in simulating the complex processes related to precipitation (Staudinger et al. 2015). Specifically, in Virginia the NCA projects a 6 percent increase in precipitation (Melilo et al. 2014). Observation data has already shown an 11 percent increase in the amount of precipitation occurring during a storm (intensity) within the state from 1948 to 2011 (VIMS 2013; Madsen and Wilcox 2012). Models project that storms will become more intense along the Atlantic Coast region (Staudinger et al. 2015). Frequency of extreme storm events has also increased over the last 50 years (VIMS 2013). More intense or frequent storm events will likely result in an increase in storm surges and flooding in coastal areas (CCSP 2009; VIMS 2013; Staudinger et al. 2015).

Sea-level rise is also likely to be significant in Virginia, with recent studies projecting rates higher than originally estimated on the East Coast (Sallenger et al. 2012). Historic data demonstrates that sea levels have risen over 1.5 feet in the Mid-Atlantic region since 1900 and a foot in the last 80 years in the Hampton Roads area (Staudinger et al. 2015; VIMS 2014). Models also project that the region may see 1.5 to 6 feet of sea-level rise by the end of the century (Staudinger et al. 2015). A recent study conducted by VIMS for the state of Virginia projects a range of approximately 1.5 feet to over 7 feet of sea-level rise by 2100. The study recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013).

Climate Change and Species and Habitats

Understanding these potential climate impacts is important for designing short-term conservation strategies and actions to protect Virginia's fish and wildlife and the habitats where they live. Although some of these impacts may not occur in the next 10 to 25 years, it is very possible that extreme heat wave or storm events may occur earlier than average temperature or precipitation increases and have a more significant, immediate, effect on resources. These extreme events rather than averages will likely have the greatest impacts on species (Klopfer et al. 2012). Warmer winter temperatures could also affect vegetation phenology, which could have cascading impacts on wildlife species that depend on them (Staudinger et al. 2015). Another example involves cold water streams and dependent species. A cold water streams is defined in Virginia as a stream whose average annual water temperature does not rise above 70°F. If a heat wave in the summer increases water temperature over 74°F for a week or more, this temperature may appear to have a small impact on the stream's annual average water temperature, but it could cause the local extirpation of many species that are impaired by summer water temperatures warmer than 70°F (Klopfer et al. 2013).

DGIF worked with partners and CMI to develop a species climate vulnerability assessment (Kane et al. 2013). This project is described in detail in the Methods Section, but it provided significant climate data for Virginia and neighboring states as well as projections of climate impacts for a suite of SGCN from the original Action Plan. Based on this work and other research, some generalizations can be made about climate impacts on species in the state. For example, species that are at the southern end of their range in Virginia, such as red spruce may be lost as temperatures increase and habitats may become too

warm. Conversely, species at the northern end of their range, such as southern red oak or bald cypress, may be able to expand further within Virginia as habitats become more hospitable. As forest composition potentially changes, the range of wildlife species that depend on these habitats may also be altered. Temperature changes may also affect species that have narrow temperature tolerances such as cold water fish species, amphibians, and some reptiles and mammals (Kane et al. 2013).

Increased amounts of precipitation, especially in winter and spring, may result in flashier stream conditions, exacerbating water quality issues such as erosion and sedimentation, stormwater runoff issues, and nutrient pollution. Additionally, if precipitation increases occur earlier in the year and taper off in the summer when temperature increases, drought conditions would become more severe. This would affect water quality conditions, especially the concentration of nutrients and pollutants, directly affecting wildlife, fish, and invertebrate species. Sea-level rise will allow salt water to inundate areas further inland; affecting both freshwater and brackish wetlands. Increasing salinity levels would affect both plant and fish and wildlife species that have narrower salinity tolerances. More extreme storm events may result in significant and prolonged inundation may affect habitat availability for species such as shorebirds, waterfowl, and migratory birds that depend on coastal wetlands within Virginia for food, nesting, and wintering habitat.

It is important to consider, however, that these climate projections and potential impacts are generalizations, and the variability of actual climate impacts and species responses makes it difficult to provide detailed information about how individual species will respond to climatic changes. Species distribution will not just move to higher altitudes or upstream, but their movement will be based on a combination and interaction of factors. It is likely that climate change will result in species expanding or contracting their ranges in unexpected ways due to new and unique habitat conditions being created (Kane et al. 2013). Additional factors that will affect habitat and species distribution and movements include vegetation structure, landscape characteristics, topography, and soil characteristics. It is unlikely these features will change as rapidly as climate. How these variables interact will determine the success or failure of species in specific areas on the landscape (Kane et al. 2013). For example, while climate factors may increase the probability of occurrence for bobwhite quail in an area, the species' response is more likely to be influenced by habitat conditions on the ground. If landscapes are not managed to provide suitable nesting, brood-rearing, and escape cover, it is unlikely quail populations will be able to increase their populations or expand their distribution regardless of how favorable the climate becomes. Conversely, using proven habitat management strategies that can help address climate impacts, wildlife managers may be able to help species, such as quail or brook trout, withstand inhospitable conditions for a longer period of time (Kane et al. 2013).

Conservation Lands and Climate Assessment

Another way to consider climate impacts involves how climate change may affect "on the ground" conservation management, specifically in terms of conserved lands. The Conservation Lands and Climate Assessment (see Approach and Methods Section) considers how climate classes (enveloped) may change across Virginia and what that may mean for lands currently held in some form of conservation. The assessment identifies 9 climate classes (envelopes) based on combined temperature-precipitation for Virginia on both conserved and non-conserved lands. In comparing climate classes on conserved and non-conserved lands in the late 20th century to those projected for 2070, 2 climate classes present in the late 20th century are likely to be absent in the late 21st century (classes 34 and 54). The climate class with the largest loss (by area) on conserved lands is class 44 with a nearly 80 percent reduction in distribution by 2070 across the study area (Table 3.5) (Figures 3.7 and 3.8) (Klopfer and McGuckin 2015).

Table 3.5. Proportion of Climate Classes within Conserved and Non-Conserved Lands in Virginia (Klopfer and McGuckin 2015).

	Late 20th Century		Late 21st Century	
Climate Class	% of Non CLN	% of CLN	% of Non CLN	% of CLN
34	2.7%	12.3%	0.0%	0.0%
35	4.8%	7.9%	1.2%	2.6%
36	1.7%	0.2%	2.2%	1.4%
37	0.1%	0.0%	0.9%	0.1%
44	39.4%	42.1%	8.5%	3.3%
45	25.4%	14.9%	34.2%	52.2%
46	0.2%	0.1%	7.6%	10.3%
47	0.0%	0.0%	0.3%	0.0%
54	17.9%	14.2%	0.0%	0.0%
55	7.8%	8.3%	34.0%	21.7%
56	0.0%	0.0%	11.2%	8.5%

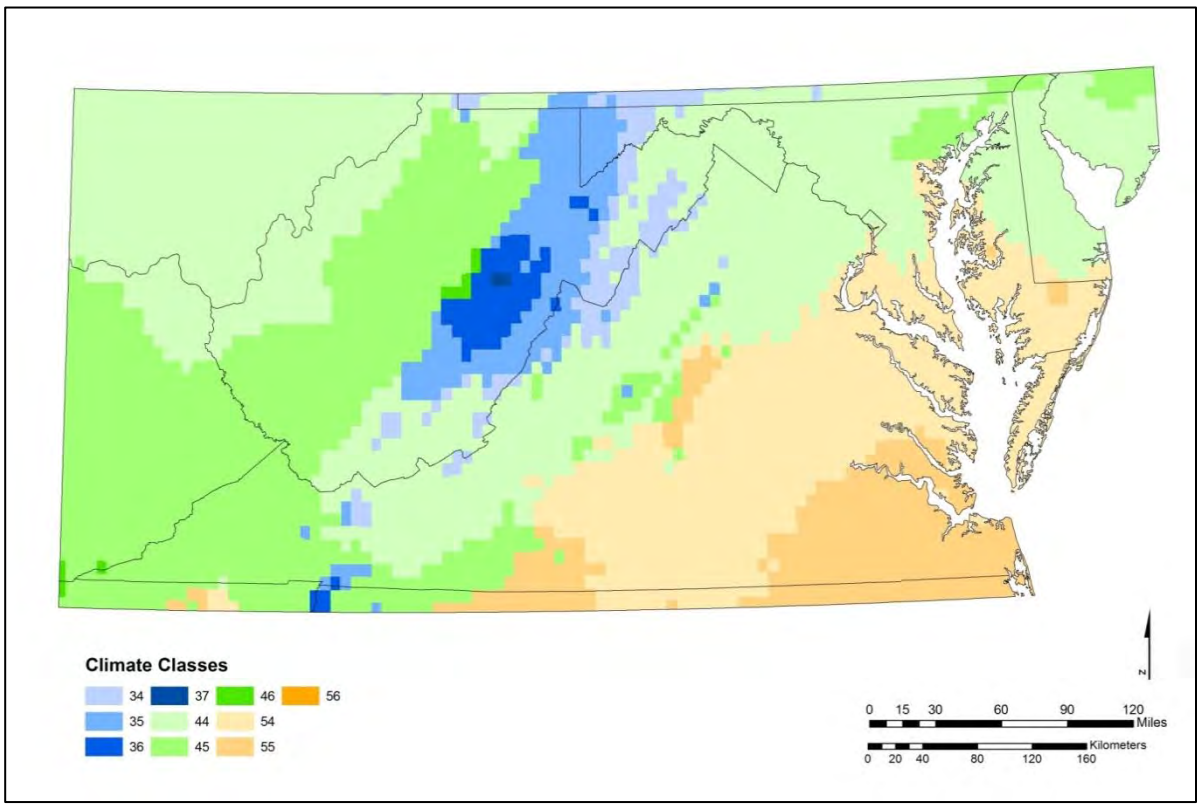

Figure 3.7. Climate Classes across Virginia in 2000 (Klopfer and McGuckin 2015).

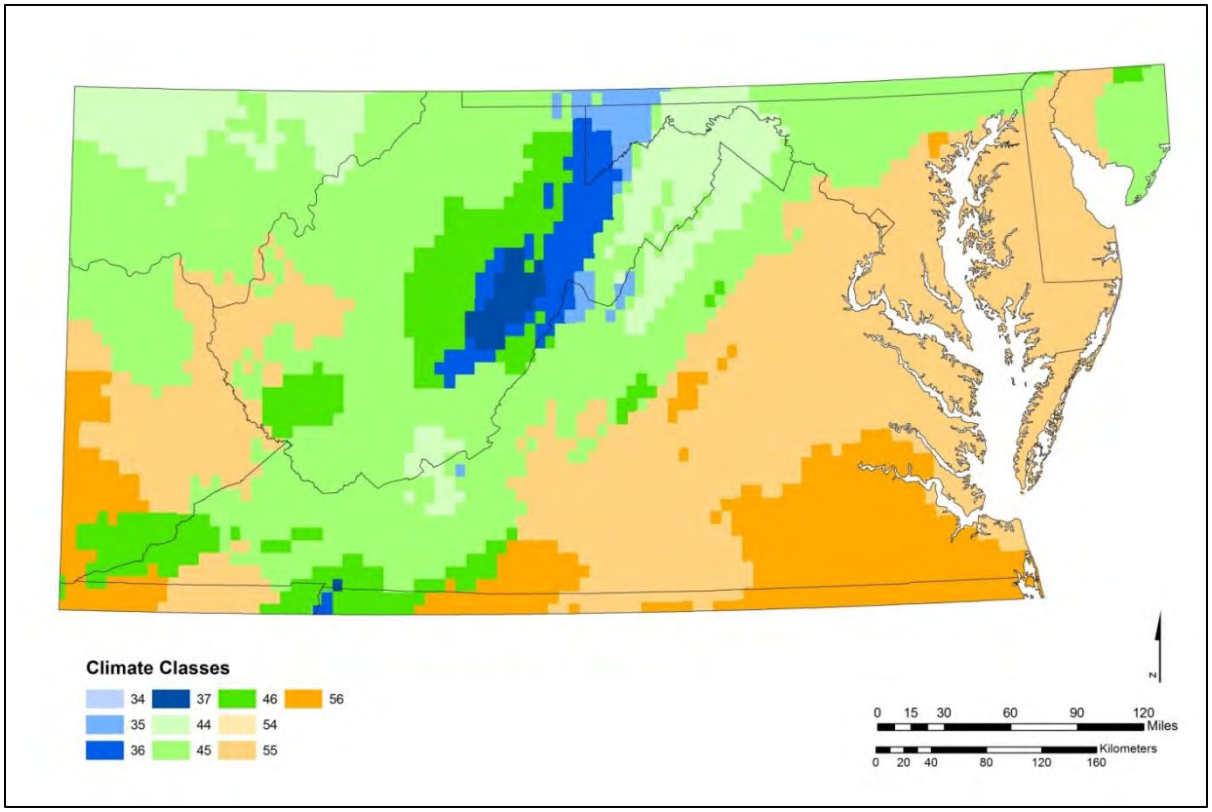

Figure 3.8. Climate Classes across Virginia in 2070 (Klopfer and McGuckin 2015).

The climate changes projected to occur across Virginia will result in shifting patterns from those evident in the late 20th century. While some climate classes will disappear completely, opportunities to bolster protection of other types with decreasing representation do exist. Further, some types with limited representation on current conservation lands will increase in composition into the future suggesting immediate actions to preserve those types may be unnecessary.

An example of a climate class that will disappear completely is climate class 34, which corresponds to the colder and drier areas of the higher elevations and latitudes in Virginia. While there is no direct evidence to support correlations between the climate classes used in this analysis and species distributions, it is interesting to note that this region has already been identified as containing species at the southern extent of their range (e.g., northern flying squirrels, snowshoe hare, etc.). Previous studies have suggested that these types of species are among the most vulnerable to climate change impacts due to the rarity of these habitat types and their relative isolation from other suitable habitat areas (Heller and Zavaleta 2009). The disappearance of this climate type from the landscape suggests that the resiliency of the landscape for supporting these species is low and that localized extirpation is a possibility.

On the other hand, dedicated habitat improvement actions may provide some level of mitigation of impacts and adaptation opportunities. For example, the range of the ruffed grouse extends southward along the Appalachians into the Carolinas even though the species core range is the Great Lakes and Northeast regions. Historically, this species was likely more widespread throughout the southeast, but their range has contracted to the highest elevations with increasing temperatures since the last glacial period. The persistence of this species on the landscape may have to do with an abundance of early successional forest regeneration following primary clearing after colonization and sustained through the early to mid-20th century.

Similarly, dedicated habitat management for target species may decrease the overall impacts of climate change for select species and locations. Further using models and analyses like these, managers may be able to identify areas to receive focus more intensive habitat management with sufficient lead time to allow for long-term activities to become effective. For example, understory tree manipulations performed today would affect the canopy characteristics 40 or more years from now and benefit target species. These actions could allow an improvement of overall habitat value and compensate for losses due to changing climate.

On the Ground Conservation Actions

In reviewing the list of SGCN, DGIF staff and partners were asked to assign each species into one of three triage categories related to conservation and management opportunity (see Methods and Approach Section). Category A was reserved for instances when managers have identified “on the ground” strategies expected to benefit species and/or habitats. Category A also requires that at least some of these strategies be able to be implemented with existing resources and have a reasonable chance of improving a species’ conservation status.

Of the 883 SGCN identified for 2015, 207 (23.4%) are classified in Category A. For these species partners identified 31 basic management actions that could be implemented to improve their conservation status. The list of 31 actions follows. The number following each action represents the number of species to which that action applies. For specific actions identified for each of the 207 species, please see Appendix A.

1. Address water quality impairments (82)
2. Implement captive propagation/ translocation/ reintroduction (45)
3. Conserve/ restore wetland habitats (27)
4. Create/ restore/ manage – open habitats (glade, grassland, savanna) (21)
5. Engage in public education/ outreach (14)
6. Conserve/ restore of beaches, dunes, and mudflats (14)
7. Exclude/ manage human use of habitats at specific times (primarily beaches) (13)
8. Engage in predator control (12)
9. Control invasive plant and animal species (9)
10. Exclude humans from caves occupied by sensitive species (8)
11. Maintain the quality and quantity of water flowing into karst and other groundwater systems (8)
12. Continue environmental commenting and engagement with industrial citing for wind energy (6)
13. Manage diversity of young and old forest habitats (5)
14. Regulate legal harvest (4)
15. Restore aquatic connectivity (4)
16. Protect known fall roosts and swarm areas for bats (4)
17. Conserve/ restore large forest blocks (3)
18. Work with industry to modify operation of wind farms during fall migration period (2)
19. Develop professional standards for wildlife control operators (2)
20. Research use of artificial nest boxes (2)
21. Enforce collection laws (2)
22. Protect (aquatic) spring habitats (2)
23. Conserve/ restore occupied canebrake rattlesnake habitat (1)
24. Conserve/ restore coastal eel grass beds (1)
25. Conserve/ restore migratory habitats for birds in coastal areas (1)
26. Create artificial wetlands (1)
27. Modify and enforce baitfish regulations (1)
28. Reduce/ eliminate heavy metal and pesticide contamination (1)
29. Maintain/ create artificial roost structures (1)
30. Restore the freshwater drum – fish host of the fragile papershell (1)
31. Conserve/ protect specific habitats occupied by the Virginia fringed mountain snail (1)

PRIORITY RESEARCH NEEDS

Conservation Opportunity Ranking Category B was reserved for those species that met one of two conditions. Either managers have identified specific research needs that must be addressed before more "on the ground" actions can be initiated or the conservation community has been precluded from implementing "on the ground" actions due to a lack of personnel, funding, or other circumstances. Of the 883 SGCN, 63 (7.1%) are assigned to Category B. The list of research needs for these species follows (no priority order). In future budget discussions, it is DGIF's intention to use this list to prioritize the research projects funded through State Wildlife Grants.

- Improve detection methods for hellbenders to better estimate population size and distribution – both to document initial conditions as well as to help evaluate effectiveness of conservation actions.
- Investigate the utility and opportunity of using translocation as a management and recovery tool for hellbenders.

- Assess the impacts of wind farms on migratory birds in the coastal region to enhance species management, habitat management, and environmental commenting.
- Determine American woodcock wintering and breeding abundance to facilitate creation of a management strategy.
- Determine how or if a growing peregrine falcon population on the Eastern Shore impacts red knot populations.
- Research belted kingfisher, black-billed cuckoo, chimney swift, eastern wood peewee, green heron, and northern flicker to determine the circumstances that threaten these species and the impacts of these threats to populations so that appropriate management strategies can be developed.
- Develop conservation plans for a the following species:
    - Variegate darter,
    - Tennessee darter,
    - Atlantic sturgeon, and
    - Marine mammals, including Atlantic bottlenose dolphin, harbor porpoise, fin whale, humpback whale, northern right whale, West Indian manatee.
- Determine if the following species would be suitable candidates for reintroduction into suitable, vacant habitats:
    - Duskytail darter,
    - Ashy darter,
    - Candy darter,
    - Greenfin darter,
    - Longear sunfish,
    - Orangefin madtom,
    - River redhorse,
    - Sauger,
    - Smallmouth redhorse, and
    - Spotfin chub.
- Investigate the issue of "genetic swamping" to determine if contact with rock bass populations is a critical threat to the genetic distinctiveness of the Roanoke bass.
- Determine if conservation of the roughhead shiner is limited by competitive interactions with the telescope shiner or other members of the genus *Notropis*.
- Determine if or how changing climatic conditions are affecting the Allegheny pearl dace.
- Determine if or how changing climatic conditions are affecting the Swannanoa darter.
- Locate maternity colonies of the eastern big eared bat populations.
- Determine effects of wind turbines on eastern big eared bat and Indiana bat populations.
- Determine the extent and effects of insecticide contamination and bioaccumulation on eastern big eared bat and Indiana bat populations.
- Assess coastal migration patterns for hoary bats, silver-haired bats, red bats, and Virginia big eared bats.
- Determine why various bat species appear to be attracted to wind turbines and work to develop deterrents.
- Evaluate the productivity and survivorship of little brown bats, northern long-eared bats, tricolored bats, southeastern myotis, and eastern small footed myotis at maternity colonies as a means of evaluating the success of conservation actions.
- Identify foraging habitat preferences for Virginia big eared bats.

- Determine if the following freshwater mussel species are suitable candidates for captive propagation and, if so, develop propagation techniques:
    - Appalachian monkey face,
    - Crackling pearly mussel,
    - Deer toe,
    - Cumberland monkey face,
    - Fine rayed pig toe,
    - Tennessee club shell,
    - Rough rabbits foot,
    - Shiny pigtoe,
    - Elephant ear,
    - Tennessee heel splitter,
    - Tennessee pig toe,
    - Slabside pearly mussel,
    - Northern Lance mussel,
    - Pimpleback,
    - Pistol grip,
    - Spectacle case,
    - Three ridge, and
    - Pink heelsplitter.
- Resolve taxonomic confusion between the purple bean and the Cumberland bean so appropriate brood stocks can be identified to support captive propagation efforts.
- Determine the genetic distinctiveness of alewife floater populations in the Rappahannock, Pamunkey, James, Chickahominy, and Chowan basins so propagation and reintroduction strategies can be developed.
- Determine if the Virginia pigtoe is a distinct species or a population of the Atlantic pig toe.
- Determine if sufficient numbers of slippershell mussels exist to serve as brood stock for a captive propagation program.
- Determine if the two known populations of Bunting's crayfish in Virginia (one in the Big Sandy Basin and the other in the Clinch River) represent one species or two so appropriate management and conservation strategies can be developed.

SGCN Distribution, Abundance, and Life History Information

The vast majority (69.5%) of Virginia's 883 SGCN species were included in Management Opportunity Category C. Species were included in this category for one of two reasons. In many cases, such as the Shenandoah salamander, conservation opportunities have been exhausted. While this species may remain imperiled, no additional actions can be taken on their behalf as the only known population in Virginia is contained within a National Park system.

Category C was also used when managers were unable to identify "on the ground" actions or research needs that could benefit the species or its habitats. The vast majority of these species lack the basic distribution, abundance, and life history information needed to formulate a management strategy or applied research program. This is an overwhelming issue, affecting many SGCN. However, given current personnel and financial resource limitations, it is a logistical impossibility that DGIF and partners will ever be able to fully address this data need.

It is DGIF's intention to continue to commit some portion of State Wildlife Grant dollars to collect baseline data on Category C species. However, this list of species will be reviewed and prioritized to ensure that resources are used efficiently and efforts provide the greatest management utility in terms of keeping species from becoming endangered.

Before Virginia's next Action Plan is written (2025), DGIF will institute a prioritization process, involving DGIF biologists and administrators, as well as representatives from other state, federal, and private organizations that will identify priority species and areas for collecting baseline species and habitat data.

Propagation and Restoration of SGCN

Virginia's aquatic habitats support some of North America's most diverse assemblages of aquatic mollusks, fish, and crayfish. Historic and continuing loss of habitat and habitat fragmentation, water pollution, sedimentation, invasive species introductions, hydrologic modification and impoundments have reduced many of these populations to critical levels and severely restricted many species' distribution.

Virginia has a long history of propagating game fishes in hatcheries to augment existing populations and establish new populations in unoccupied habitats. In 1997, Virginia Tech's Freshwater Mussel Conservation Center began propagating and releasing endangered mussels to augment wild populations. In 1998, DGIF established the Aquatic Wildlife Conservation Center (AWCC) near Marion, Virginia to restore populations of imperiled mussels in the Upper Tennessee River drainage. The AWCC has also propagated the endangered spiny river snail (*Io fluvialis*) and eastern hellbenders (*Cryptobranchus alleganiensis*). In 2007, the DGIF and USFWS established the Virginia Fisheries and Aquatic Wildlife Center (VFAWC) at the Harrison Lake National Fish Hatchery in Charles City County to propagate mussels for release into Virginia's Atlantic slope rivers. Since 2010, DGIF has contracted with Conservation Fisheries Inc. to propagate and release federally endangered yellowfin madtom (*Noturus flavipinnis*) into the upper reaches of Copper Creek, a tributary of the Clinch River. Efforts are also underway to propagate and release yellowfin madtoms into the North Fork Holston River.

It is DGIF's intention to continue supporting these propagation and restoration activities with State Wildlife Grants and other resources. While current SGCN efforts largely focus on aquatic species, species in other taxonomic groups may also be considered as appropriate. The target species, the use of State Wildlife Grants, and the priority of individual efforts will be determined during DGIF's project planning, annual budget development, and annual work planning efforts.

DATA MANAGEMENT FOR MIGRATORY SPECIES

Virginia's 2015 Action Plan identifies dozens of migratory birds, fish, and insects that, throughout the course of their life, cross regional, national, and international borders. State fish and wildlife agencies collect and compile a wide variety of biological and ecological data which, when assembled with similar data collected by other states, regions or countries can greatly enhance our ability to evaluate trends in species population sizes and distribution, habitat losses and gains and other common parameters across broad geographic areas. Unfortunately, these disparate data are rarely compiled or managed to provide biologists with "the big picture" that would better inform local conservation efforts. As more migratory species are included within Action Plans, there is a growing need among managers to coordinate survey

and monitoring efforts, using standardized data collection methods and protocols. To be most effective, this data should be compiled and managed in a centralized database that is accessible to all users. Such a system has been developed to support waterfowl conservation and management. Lessons learned by the waterfowl community can inform and enhance efforts for other taxonomic groups.

Unfortunately, the USFWS lacks the human, financial, and technical resources needed to develop, house, and manage such a large and long-term data effort. In response, state wildlife agencies are exploring opportunities to:

- Develop a partnership agreement, guiding data ownership, use, and management access;
- Establish a storage location for the assembled data that can be accessed by the partners;
- Establish a database or data warehouse (i.e., a set of databases) with a mapping component that can display the data; and
- Partition development costs and annual costs of long-term database QC/QA and general maintenance responsibilities among data-contributing states.

Developing such a system would enhance Virginia's ability to contribute to the conservation of species that cross multiple jurisdictions. The use of State Wildlife Grants to support this effort will be considered as part of DGIF's annual budgeting process.

INTERNATIONAL CONSERVATION

Dozens of migratory SGCN songbirds, waterfowl, shorebirds, and the monarch butterfly utilize habitats in Virginia as part of their annual migratory cycle. Due to threats impacting these species in other states or countries, conservation efforts in Virginia may be insufficient to ensure the long-term conservation of many of these species.

DGIF currently participates in several multi-stakeholder programs (Joint Ventures, Fly-Way Council, Partners in Flight, Southern Wings Program) that work to monitor and conserve these migratory species. As part of these collaborative efforts, DGIF may consider using a portion of its State Wildlife Grant allocation to conserve habitats or conduct research in other jurisdictions if those efforts have the potential to improve the status of one or more of Virginia's SGCN. DGIF's participation with such a project would be considered as part of DGIF's annual budgeting process and contingent upon an internal review by appropriate agency staff.

NORTHEAST WILDLIFE DIVERSITY TECHNICAL COMMITTEE AND THE REGIONAL CONSERVATION NEEDS PROGRAM

The Northeast Association of Fish and Wildlife Agencies, traditionally, has supported a strong technical committee structure to further wildlife conservation. Technical committees are species or habitat-focused groups that exchange ideas and develop common approaches to wildlife issues. Typically, these conservation actions are implemented by individual states using their own funds; however, in some cases additional funding has been made available through the Northeast Wildlife Agency Directors. In one such case, the Directors established the Regional Conservation Needs (RCN) Program which is managed by the Northeast Wildlife Diversity Technical Committee.

The RCN Program utilizes a small percentage of each state's annual State Wildlife Grant allocation to address SGCN needs across multiple states. Specifically, the RCN Program is used to coordinate and implement conservation actions that are regional/ sub-regional in scope and build upon the many regional initiatives that already exist. Since 2007, thirty-seven different projects have been implemented. The resulting reports and products can be found at RCNgrants.org. Output measures related to the RCN Program include monitoring the number of conservation actions and research projects selected by the participating agencies, the number of projects completed by the funding recipients, and the number of articles, publications, and technical reports developed each year as a result of funded projects.

It is DGIF's intent to continue contributing SWG funds and personnel resources to support the RCN program and the Northeast Wildlife Diversity Technical Committee.

CONCLUSION

From a statewide level, reviewing conservation needs in this Action Plan may be discouraging as hundreds of species are identified as being of greatest conservation need. Many species populations are already critically impaired, and their long-term survival is in doubt. Management concerns over the loss or degradation of Virginia's aquatic, wetland, terrestrial, subterranean, and coastal habitats, which will likely be compounded by the potential impacts of climate change, land subsidence, invasive species, and sea level rise, are not inconsequential. If we fail to address these issues, more species could be legally classified as endangered, which could have profound impacts for people, businesses, and communities, as well as wildlife.

Alternatively, the statewide chapter can be viewed from the perspective of implementation. The chapter focuses on what the conservation community can do to best protect and conserve species and habitats within the Commonwealth. Management actions have already been identified for scores of these species and habitats that, if implemented, are likely to benefit hundreds of additional SGCN. Important research needs have been identified that should allow conservation partners to implement more "on the ground" conservation for dozens of species. Many of the threats affecting Virginia's terrestrial and aquatic habitats can be addressed with known techniques and technologies. In several cases, habitat programs already exist. Finally, and perhaps most importantly, Virginia has a robust and dedicated conservation community, comprised of agency and NGO staff, academics, and talented enthusiasts, who have proven that great things can be accomplished when efforts are focused and burdens are shared.

Sir Patrick Geddes (1854 – 1932) was a Scottish sociologist, geographer, and town planner who is credited with championing the notion that biogeography, geomorphology, and human systems are interrelated and that the healthiest communities recognize the importance of, and manage to maintain, the health of these relationships. Geddes work has often been credited as the inspiration for the slogan "Think Globally, Act Locally" used by grassroots activists worldwide. In this tradition, it is DGIF's intent that the revised Action Plan will define problems based on areas of common interest. This updated version was created to find ways to keep species from becoming endangered. While this perspective may seem limited, the majority of conservation issues we face are not just "wildlife issues" but are, in fact, Virginia issues for which wildlife are an indicator. Clean and healthy rivers are important for

wildlife, people, communities, and industries. Healthy riparian forests, wetlands, and upland habitats provide people with economic and recreational opportunities, while also supporting diverse wildlife species and helping to ensure clean water flowing thru our landscapes. As waters flow from Virginia towards the Atlantic Ocean or the Gulf of Mexico, these rivers, and their adjacent habitats, support even more species, communities, industries and recreational opportunities. Working to keep species from becoming endangered benefits our communities, our economy, and our quality of life by addressing the problems that exist within our collective habitats and preventing them from becoming a crisis.

Based on the idea that local actions can generate regional shared benefits, and using a format perfected by the Virginia Department of Conservation and Recreation, this Action Plan was created around 21 Local Action Plan Summaries. Each of these local chapters describes the wildlife and habitat priorities identified by DGIF and partners within each multi-county planning region. These local chapters are not mandates. Rather, they identify shared problems and describe the types of actions that can be taken to address conservation priorities. Ideally, these summaries will inspire collaboration among the conservation community and provide guidance as to how limited time, money, and people can be utilized to best effect. Groups with other focuses such as clean water, open space, outdoor recreation, commercial fisheries, or civic enhancement may use these documents as a means of forging new collaborations that achieve mutual goals. By defining collective problems, the Local Action Plan Summaries may provide opportunities to find or develop new conservation funding and resources.

The problems outlined within this revised Wildlife Action Plan can be addressed. It will require time, resources, and dedication, and a little luck. It is within our ability to prevent many of these species from becoming endangered while also doing beneficial things for human communities. Like any thousand-mile journey, this one will start with the first step.

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5. Accomack-Northampton Planning Region Local Action Plan Summary

WILDLIFE ACTION PLAN AND LOCAL SUMMARIES OVERVIEW

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife and Conservation Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. The rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. Rankings also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat, or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A, 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

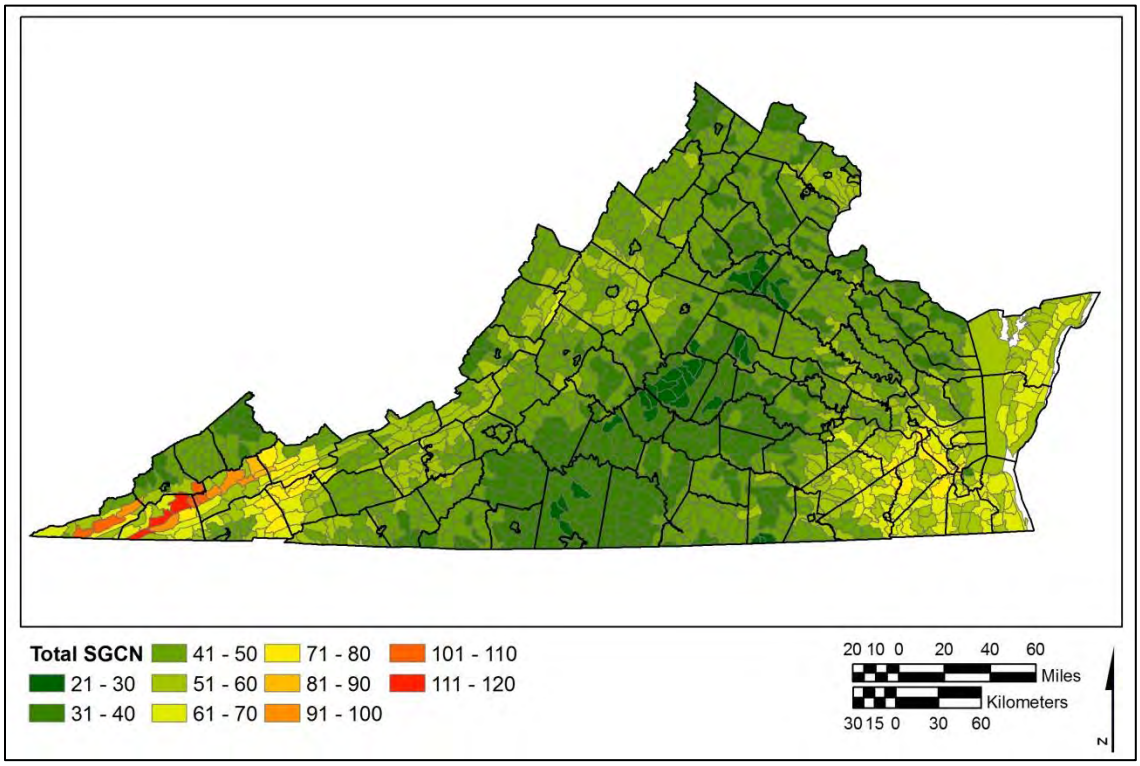

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries (Local Summaries) create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

ACCOMACK-NORTHAMPTON LOCAL PLANNING REGION SUMMARY OVERVIEW

The Accomack-Northampton Planning Region consists of 1,356,989 acres (2,120 square miles) and includes Accomack and Northampton counties and the town of Chincoteague. There are no large population centers within this planning region, and human populations are relatively low compared to other portions of the state (e.g., Accomack County has approximately 33,000 residents, and Northampton County has approximately 12,000 residents per the 2010 census) (U.S. Census Bureau 2015). However, the region's human population is expected to grow by 30 percent over the next 20 years (VIMS 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. This planning region is especially important to the conservation of countless bird species that migrate to or through this area as part of their annual cycles. Examples include the American black duck, the American oystercatcher, the willet, and scores of other shorebirds, waterbirds, waterfowl, song birds, and raptors. Virginia's Eastern Shore is also home to several species that are not found in any other part of Virginia, such as the New Jersey chorus frog and the Delmarva fox squirrel. Additionally, this planning region contains some of the best remaining examples of rare maritime forest habitats in Virginia. It also includes a variety of other habitats: mature mixed hardwood forests, young forests, retired agricultural land, tidal wetlands, tidally influenced streams and riparian habitats, beaches and dunes and mudflats, and marine habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during the development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

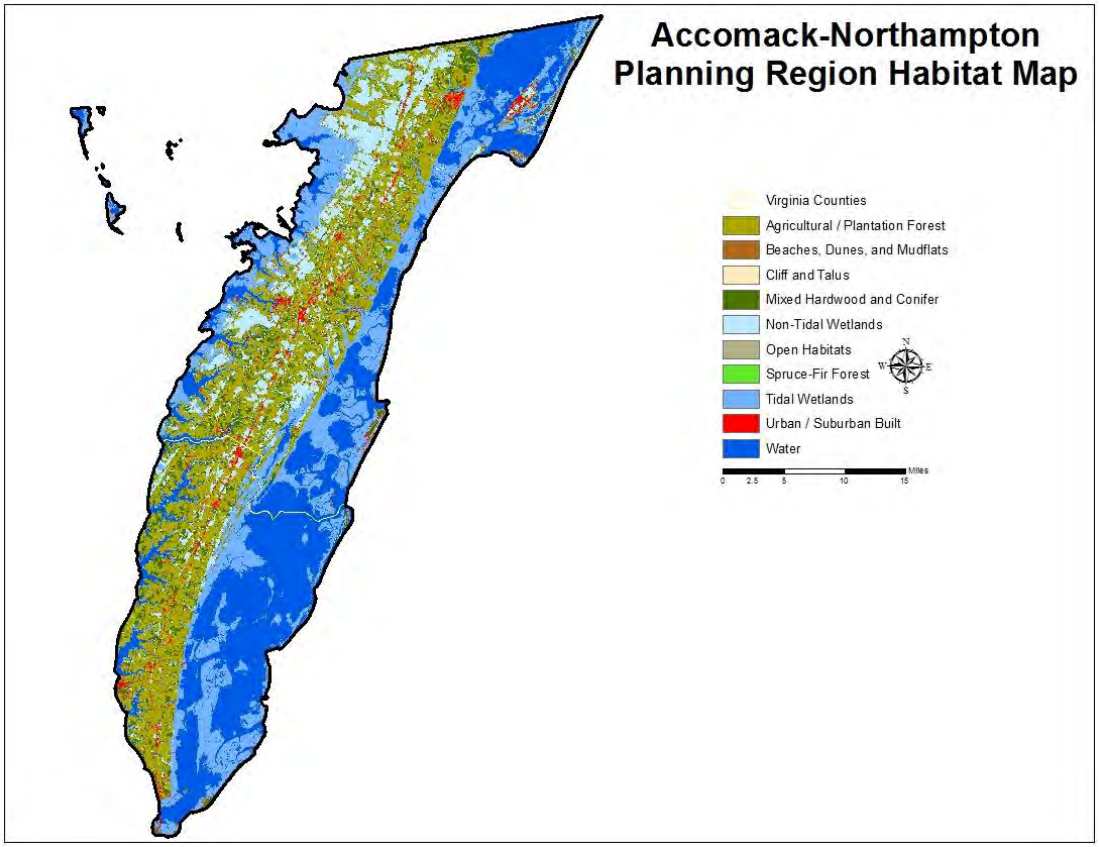

Figure 2. Accomack Northampton Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 79 are believed to either occur, or have recently occurred, within the Accomack Northampton Planning Region (Appendix A). Of these 79 species, ***67 SGCN are dependent upon habitats provided within the Accomack Northampton Planning Region. These species constitute the priority SGCN for the planning region (Table 2).*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 67 priority species within this planning region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of Priority SGCN
Ia	10
Ib	3
Ic	0
IIa	7
IIb	0
IIc	1
IIIa	7
IIIb	2
IIIc	1
IVa	21
IVb	12
IVc	3

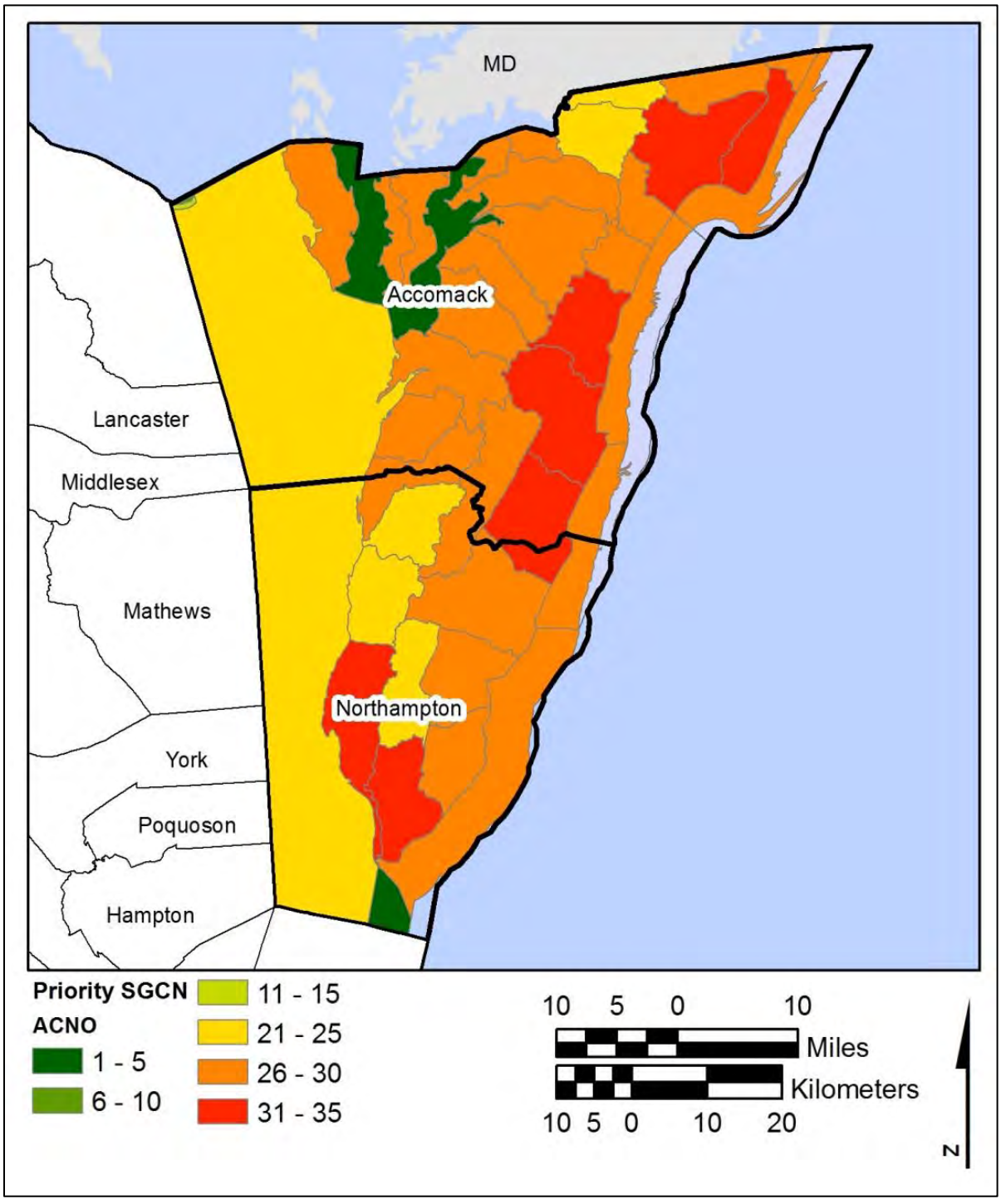

Figure 3. Priority SGCN Density in the Accomack Northampton Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within the Accomack Northampton Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	New Jersey chorus frog	*Pseudacris kalmi*	Various forests with suitable breeding sites
Bird		II	a	American oystercatcher	*Haematopus palliatus*	Barrier beaches, salt marshes, and Chesapeake Bay islands and shorelines
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*	Migratory with weak habitat associations in Virginia
Bird	**SE**	I	a	Black rail	*Laterallus jamaicensis*	High saltmarsh
Bird		II	a	Black skimmer	*Rynchops niger*	Beach species that nests on bare sand
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*	Winter resident along beaches and estuaries
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*	Variety of marshes, swamps, and wooded streams
Bird		III	a	Brant	*Branta bernicla*	Saltmarshes and estuaries
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	b	Clapper rail	*Rallus longirostris*	Saltmarshes
Bird		II	a	Common tern	*Sterna hirundo*	Nests primarily on open dynamic beaches
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*	Winter resident shorelines and estuaries

Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests.
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.
Bird		III	a	Forster's tern	*Sterna forsteri*	Nests in marine and estuarine marshes
Bird		I	a	Glossy ibis	*Plegadis falcinellus*	Wooded wetlands, estuarine marshes and waters and saltmarshes
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	a	Greater scaup	*Aythya marila*	Winter resident on tidal rivers
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird	**ST**	I	a	Gull-billed tern	*Gelochelidon nilotica*	Nests on open sandy beaches and marsh shell rakes
Bird		IV	a	Laughing gull	*Leucophaeus atricilla*	Seacoasts, bays, estuaries, rarely on large inland bodies of water.
Bird		III	a	Least tern	*Sternula antillarum*	Nest on open beaches
Bird		II	a	Little blue heron	*Egretta caerulea*	Freshwater and brackish marshes
Bird		IV	a	Marbled godwit	*Limosa fedoa*	Occur regularly in the seaside lagoon system throughout the winter
Bird		IV	b	Marsh wren	*Cistothorus palustris*	Freshwater marshes with cattails and reeds

Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.
Bird		IV	a	Northern Gannet	*Morus bassanus*	Coastal waters primarily but sometimes several hundred miles out to sea.
Bird		IV	a	Northern Pintail	*Anas acuta acuta*	Lakes, rivers, marshes and ponds in grasslands or cultivated fields.
Bird	**FTST**	III	a	Piping plover	*Charadrius melodus*	Barrier beaches and sand pits
Bird		IV	c	Purple sandpiper	*Calidris maritima*	Winter resident along beaches and jetties
Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*	Migrant along barrier islands and to a lesser extent in the Chesapeake Bay
Bird		IV	a	Royal tern	*Thalasseus maxima*	Sandy beaches
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		III	a	Saltmarsh sparrow	*Ammodramus caudacutus*	Maritime wetlands around estuaries and barrier islands
Bird		IV	a	Sanderling	*Calidris alba*	Primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers also on exposed reefs.
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*	Grassy salt marshes
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*	Migrant, migration habitat includes saltwater tidal flats, beaches, and salt marshes
Bird		II	a	Snowy Egret	*Egretta thula*	Marshes, lakes, ponds, lagoons, mangroves, and shallow coastal habitats.
Bird		IV	b	Virginia rail	*Rallus limicola*	Fresh and brackish marshes, may visit salt marsh in winter
Bird		IV	a	Whimbrel	*Numenius phaeopus*	Coastal migrant that typically occurs in a variety of saltmarsh habitats
Bird	**SE**	I	a	Wilson's plover	*Charadrius wilsonia*	Barrier beaches
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.

Bird		IV	a	Yellow-breasted chat	*Icteria viren*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory.-utilize variety of aquatic and marine habitats
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*	Migratory - utilize variety of aquatic and marine habitats
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	Beach obligate - does not tolerate heavy foot or vehicle traffic
Mammal		III	b	Atlantic bottlenose dolphin	*Tursiops truncatus*	Marine
Mammal	**SE**	II	c	Delmarva fox squirrel	*Sciurus niger cinereus*	Mature pine and hardwood forests with open understories
Mammal	FE	IV	b	Fin whale	*Balaenoptera physalus*	Marine
Mammal		IV	c	Harbor porpoise	*Phocoena phocoena*	Marine
Mammal	FE	I	b	Northern right whale	*Eubalaena glacialis*	Marine
Mammal	FE	IV	b	West Indian manatee	*Trichechus manatus latirostris*	Marine
Reptile		I	b	Green sea turtle	*Chelonia mydas*	Marine
Reptile		I	a	Kemp's Ridley sea turtle	*Lepidochelys kempii*	Marine
Reptile		I	a	Leatherback sea turtle	*Dermochelys coriacea*	Marine
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*	Nests on ocean-facing beaches and occurs in the lower Chesapeake Bay and inshore, nearshore and offshore coastal waters
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*	Barrier beaches, estuarine marshes and waters

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in Accomack Northampton Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks to state wildlife management areas, and National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- The Virginia Coast Reserve (The Nature Conservancy),
- Assateague Island National Seashore,
- Chincoteague National Wildlife Refuge,
- Wallops Island National Wildlife Refuge,
- Eastern Shore of Virginia National Wildlife Refuge,
- Fisherman Island National Wildlife Refuge,
- Kiptopeke State Park,
- Saxis Wildlife Management Area,
- Doe Creek Wildlife Management Area, and
- Mockhorn Island Wildlife Management Area and GATR Tract.

These properties contain a diversity of open water; beach, dune, and mudflat; forest; open; and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

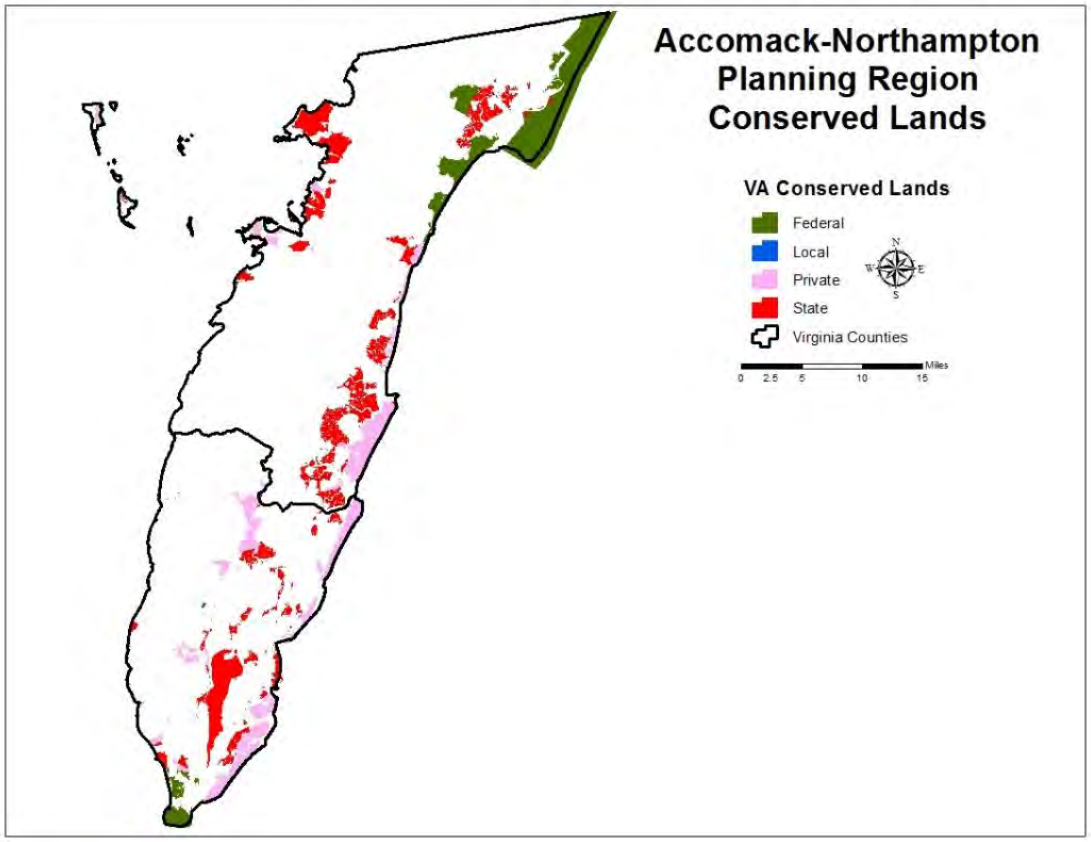

Figure 4. Conservation Lands in Accomack Northampton Planning Region (DCR, Natural Heritage 2014).

These properties serve as the backbone of wildlife conservation efforts on the Eastern Shore. Many of the healthiest and most important habitats have already been conserved within their boundaries. These properties are important for conservation, research, and monitoring. Many of these lands help protect water and habitat quality. As social, economic, and climatic conditions change, however, the conservation value of these properties could be affected. To address these types of changes, one option is to expand or buffer existing conserved lands to allow for the migration of habitats or minimize the impacts of adjacent development. It should be noted that some stakeholders on the Eastern Shore have expressed concerns that putting additional lands in conservation may hinder the economic well-being of the region and negatively impact county residents. Conversely, recent research has indicated conserved lands on the Eastern Shore attract visitors from outside the planning region and can be a significant benefit to local economies (DCR 2013; Carver and Caudill 2013). Specifically, National Wildlife Refuges bring economic and social benefits to communities (Carver and Caudill 2013). For example, in 2011 the Eastern Shore of Virginia National Wildlife Refuge provided over $2 million in local economic benefit through visitation, jobs, and tax revenue (Carver and Caudill 2013). To balance interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Accomack Northampton Planning Region

Few places in Virginia are expected to be as affected by climate change as much as the Eastern Shore. A report published by the Virginia Institute of Marine Science (VIMS) (2013) uses climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100. The report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events also are projected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are likely to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013). The report also estimates, given these projections, approximately 208 square miles of land and 326 miles of roads could be lost to sea-level rise in Accomack County, and 186 square miles of land and 44 miles of road could be lost to sea-level rise in Northampton County.

Changes in temperature and precipitation will also negatively affect habitats and SCGN in the Accomack Northampton Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality, and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer air temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats In Accomack Northampton Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Accomack Northampton Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 3. Summary of Conservation Strategies and Actions for Accomack Northampton Planning Region.

Conservation Strategies	Conservation Actions	Threats	Economic/ Human Benefits	Priority Areas
Maintain and conserve beach, dune, and mudflat habitats	1) Balance conservation, human, and economic uses for beach, dune, and mudflat habitats; 2) Maintain and support current land use and management policies on all existing conserved lands in Accomack and Northampton counties; 3) Research climate change impact on beaches and how this may affect acquisition and protection strategies of beach habitat; 4) Focus acquisition on areas inland of existing beaches to help protect them and potentially provide migration corridors; 5) Implement predator control methods such as trapping to further enhance these habitats for SGCN; and 6) Create and implement a Keep Cats Indoors outreach campaign.	Climate change, non-native and exotic invasive species, predators	Enhanced ecotourism opportunities	Chesapeake Bay shorelines and islands; areas inland of already protected beaches
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species and conduct predator control.	Water quality degradation, habitat/ land use conversion, climate change, exotic and non-native and exotic invasive species, predators	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, restore, and conserve aquatic and riparian habitats	1) Work with landowners to implement small acreage grazing systems; 2) Repair/ replace failing septic systems; 3) Establish riparian vegetative buffers along waterways; 4) Establish waste storage facilities to better manage animal waste and prevent flow into rivers; 5) Establish retention ponds or features to manage and slow storm water runoff; 6) Continue to identify impaired waters within the planning region; and 7) Work to prevent pet waste from entering waterways.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, effluence of animal waste	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Kings Creek, Mill Creek, Occohannock Creek
Maintain and restore forest habitats	1) Protect forested land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Manage forests with consideration of migratory bird species as well as other important SGCN.	Land use change and conversion, invasive species, climate change, threats to maritime forests	Flood control; water quality; ecotourism/ wildlife viewing	Forest patches adjacent to already protected parcels. Areas identified as patches important for migratory roosting

Maintain and Conserve Beach, Dune, and Mudflat Habitats

The Accomack Northampton Planning Region has extensive beach and barrier island habitats that benefit many Action Plan species. Mudflats provide important foraging areas for marbled godwits, piping plovers, American oystercatchers, and other species. Beaches and dunes are important nesting habitats for diamondback terrapins, northeastern beach tiger beetles, piping plovers, gull-billed terns, black skimmers, and numerous other migratory birds. Dunes also protect inland habitats, such as the relatively rare maritime forest communities, from the more intense storm surges and salt spray. Approximately 6,581 acres (1.1 percent of the planning region) are considered beach, dune, or mud flat habitat within the planning region (Anderson et al. 2013).

Threats

Much of the planning region's beach, dune, and mudflat habitat is either protected by state or federal agencies or owned by private organizations such as The Nature Conservancy. Many properties are also managed under conservation easements. With so much of this habitat held in a conserved status, fragmentation and commercial development are not considered a significant threat, although some partners have expressed concern about the impact of residential development on the Bayside of the Eastern Shore.

1. Climate Change: Climate change, with resulting sea-level rise and more intense storm events, will likely lead to increased coastal flooding, presenting a significant challenge for the barrier islands and low lying areas on the peninsula. The effects of flooding are further exacerbated by naturally occurring land subsidence. Severe storms as well as sea-level rise will also likely increase erosion and salt water intrusion along the coast into sensitive ecosystems.

2. Invasive Species: Invasive species such as *Phragmites* and beach vitex (*Vitex rotundifolia*) often out-compete native vegetation and reduce the value of local habitats.

3. Predators: Predators, including raccoons, gulls, coyotes, feral cats, and foxes can have a significant impact on species that utilize these coastal habitats to nest and forage.

Conservation Management Actions

Beaches, dunes, and mudflats are dynamic and have important habitat and economic value. Conservation actions will require the conservation community to work closely with agencies, landowners, municipalities, and elected officials to find a sustainable balance between conservation, human recreation, and economic development. Each of these entities has valid regional concerns that should be considered within the broader management context to accommodate the various interests.

Some partners have suggested that efforts should be made to bring privately owned beaches into some form of conservation. Such actions should be closely examined and only be considered if landowners are willingly involved. Regardless, climate projections indicate many

current beaches could be inundated by a combination of sea-level rise and land subsidence. Under such circumstances, acquiring these areas might not be a wise investment of limited conservation resources.

On Virginia's barrier islands, even a small number of predators, such as raccoons, foxes, or gulls can have a significant impact on beach nesting birds and reptiles. DGIF and others have demonstrated that trapping is an effective and efficient means of limiting the impacts of predation. As necessary, DGIF and partners will limit the size of these common predator populations to benefit the more rare bird and turtle species.

Climate-Smart Management Actions

As the climate changes and sea levels rise and land continues to naturally subside, the dynamic beaches, dunes, and mudflats are likely to move and migrate. Over time, this could bring these habitats, and the species that rely upon them, into conflict with existing land uses. Research is needed to understand how these systems are likely to change and to identify opportunities to work with willing landowners to acquire buffer properties that would facilitate movement. Until this issue is better understood, working with willing landowners to acquire properties inland and adjacent to existing conserved beaches may be a useful strategy to provide the opportunity for these habitats to migrate under changing climatic conditions. Protecting these areas can occur through acquisition or partnerships with landowners. Expanding monitoring along these areas to enable early detection and action as areas become increasingly affected by sea-level rise and storm events will be important (Glick et al. 2008).

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Eastern Shore of Virginia. In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Tidal marshes are the most common wetland type in this area (Table 4). Priority species that depend on these wetlands include the saltmarsh sparrow, black rail, Henslow's sparrow, king rail, and glossy ibis, among others.

Table 4. Wetland Acreage in Accomack Northampton Planning Region (Anderson et al. 2013).

Wetland Type	Acres	Percent of Planning Region
Tidal Wetlands	134,037.65	22.24%
Non-Tidal Wetlands	65,844.55	10.92%

Threats

The health and quality of wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of wetlands degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system

(Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the Eastern Shore.

2. Land Use Changes: Accomack Northampton Planning Region has extensive tidal wetland areas; many are under protection on state or federal lands, or private lands (those owned by The Nature Conservancy as a part of TNC's Virginia Coast Reserve). One of the most significant threats to tidal marshes outside these protected areas and to non-tidal wetlands is conversion to other uses and hardening of shorelines that can harm wetland integrity and prevent inland migration as sea levels rise. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of wetland habitat through damage or loss to wetland vegetation. Nutria eat large amounts of aquatic vegetation and destroy wetlands by burrowing into the substrate. Mute swans out-compete native species by consuming significant amounts of emergent and submerged aquatic vegetation (DGIF 2012). Mute swans can also destroy vegetation by uprooting it, thereby limiting the effectiveness of wetland restoration (DGIF 2012). Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites*, purple loosestrife, Japanese stilt grass, nutria, mute swans, and exotic invertebrates.

4. Predators: While predators, such as foxes, gulls, feral cats, coyotes, and Norway rats, do not necessarily degrade the quality of wetland vegetation, they can cause small wetlands to become less suitable for marsh-dependent species such as diamondback terrapins, black rails, or black ducks.

5. Climate Change: As sea levels rise and land continues to naturally subside, marshes will likely be inundated and become submerged (CCSP 2009; TNC 2011a). Shallow open water habitats do not support the same vegetative composition as wetlands, affecting the wildlife species that depended on tidal wetland habitats. Additionally, as storms become more intense, increased wave action and scouring may lead to significant erosion and loss of these coastal wetlands (CCSP 2009; TNC 2011a). Increased salinity levels from sea-level rise and more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands on the Eastern Shore. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods, living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate inland as conditions change (Kane 2011; VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is also important to protect the health of existing wetlands as well as to provide a potential inland migration route as conditions change (Kane 2011). Although a significant amount of wetlands in the planning region are under federal, state, and private protection, the protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals that might degrade the quality of these habitats will be important conservation actions.

Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation and The Nature Conservancy, as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas is based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). High priorities for conservation are on the southern tip adjacent to already protected lands. Moderate wetland conservation priorities exist along the Bayside of the Eastern Shore as well.

Potential areas for wetland restoration exist along the entire Bayside of the Eastern Shore, with efforts focusing on conserving and acquiring areas identified as marsh retreat zones (See Figure 7).

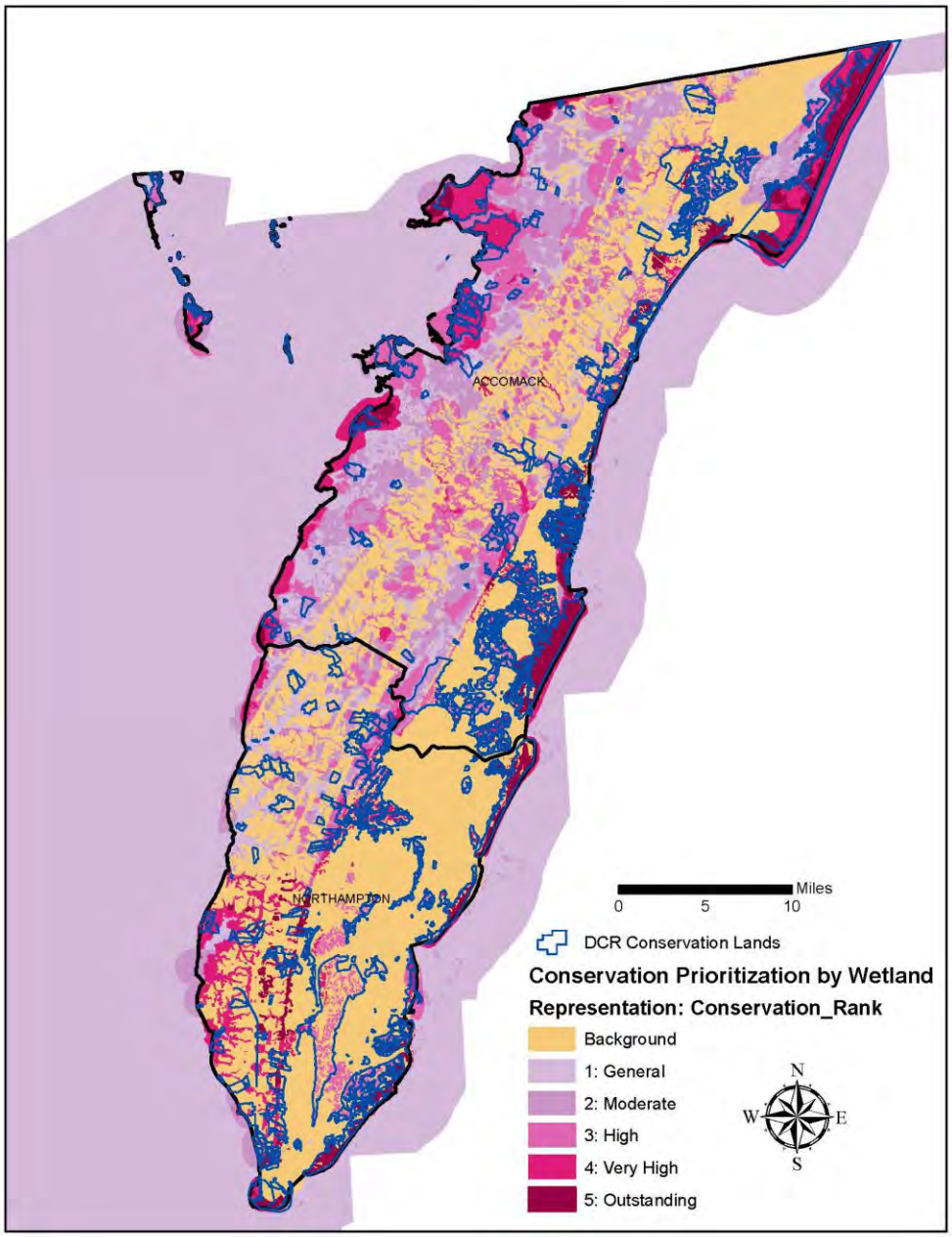

Figure 5. Priority Wetlands for Conservation in Accomack Northampton Planning Region (Weber and Bulluck 2014).

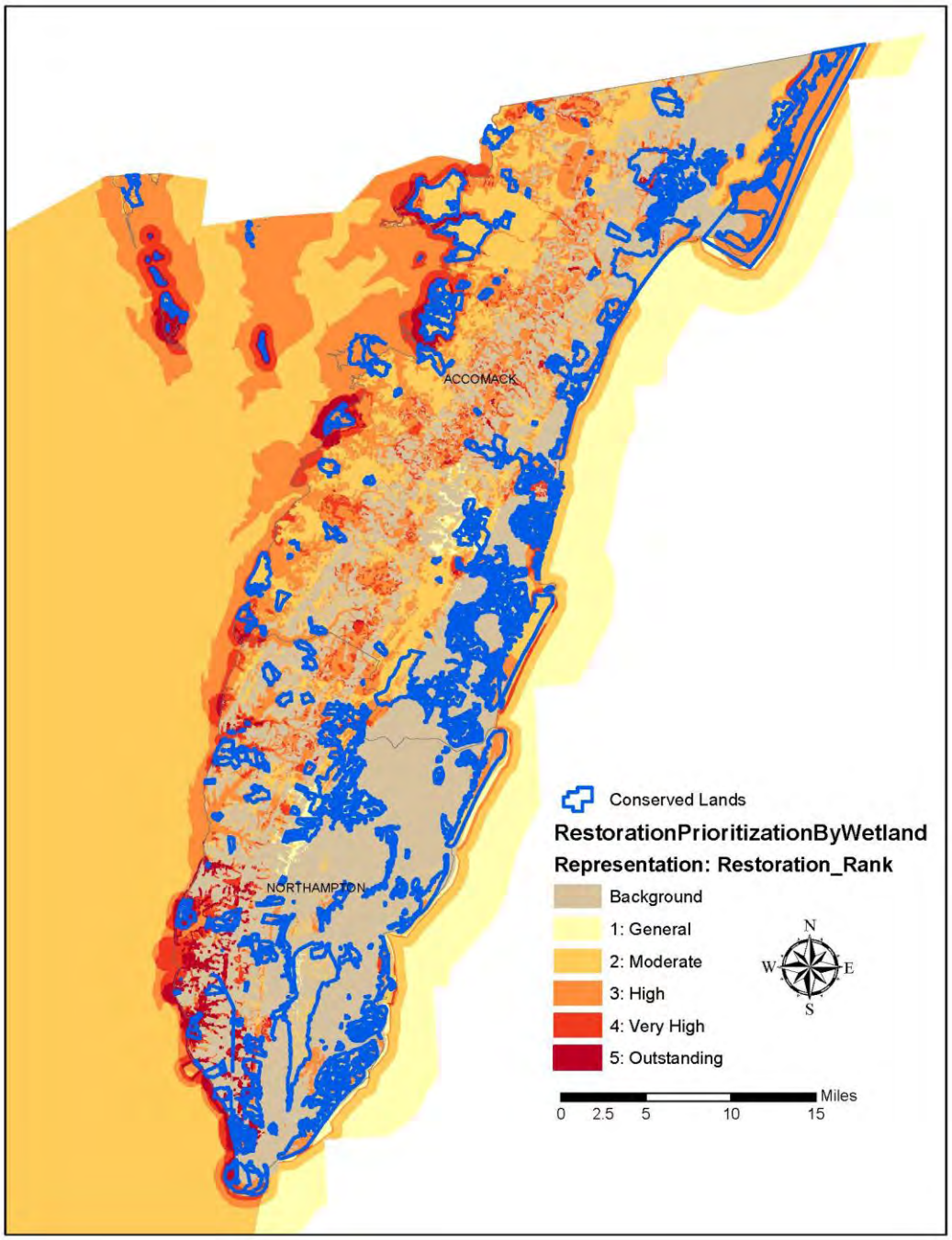

Figure 6. Wetland Restoration Priorities in Accomack Northampton Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Priority areas for wetlands protection and restoration within the Accomack Northampton Planning Region include those wetlands that may provide some opportunity for adaptation and resiliency as sea levels rise (TNC 2011b). To identify critical areas for future marsh migration (i.e., advancement or retreat) in response to accelerated sea-level rise that will enhance wetland value for wildlife by protecting and restoring these areas, a new Land Protection Tool for the Southern Tip Ecological Partnership has been developed by The Nature Conservancy and USFWS (Bruce et al. 2015). This tool can be used to evaluate individual parcels based on their potential for marsh retreat due to sea-level rise, habitat value for migratory land birds and raptors, and overall ecological integrity. Identifying these areas may also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Priority areas for protection are described as "marsh retreat zones" (Figure 7).

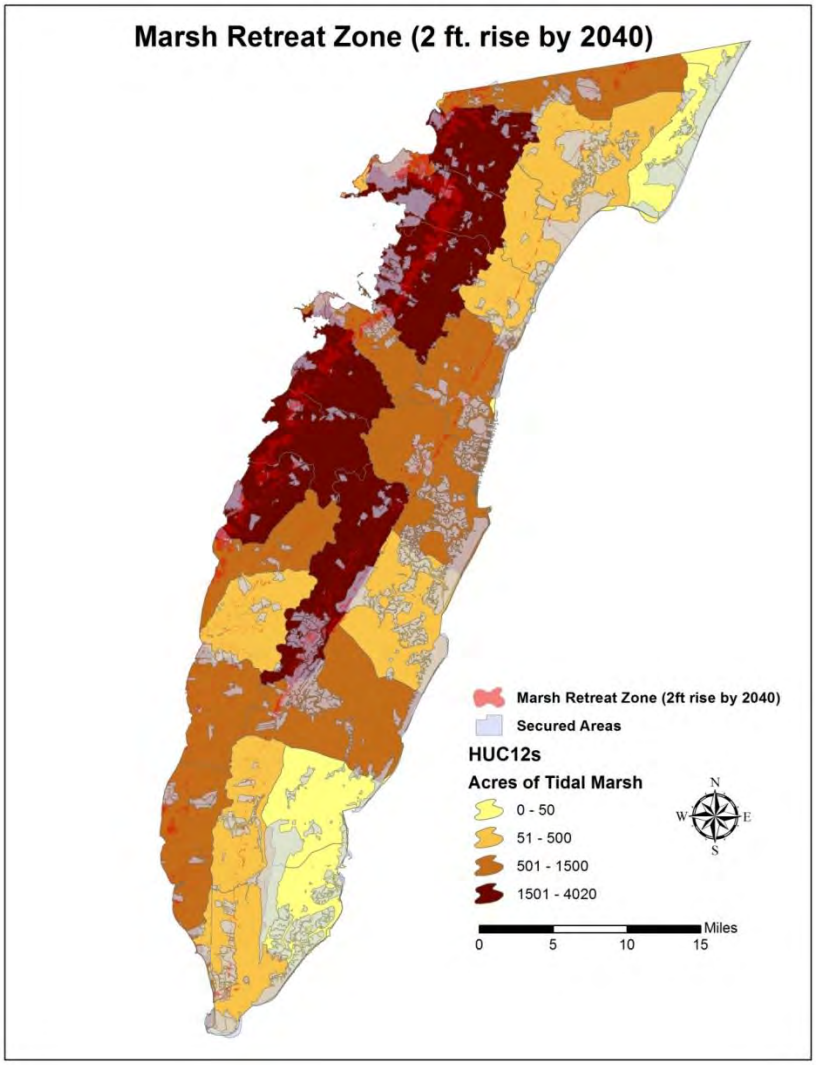

Figure 7. Projected Marsh Retreat Zone on the Eastern Shore (Bruce et al. 2015).

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels) and restoring wetlands to increase their elevation along the coast where feasible or needed.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems on the Eastern Shore include tidal creeks and streams. Any freshwater stream in the planning regions is still tidally influenced, even if minimally. These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Approximately 180,000 acres (30 percent) of the planning region is considered aquatic (Anderson et al. 2013). Priority SGCN that depend on these aquatic systems within this planning region include the Atlantic and shortnose sturgeons and little blue heron.

Threats

Aquatic and riparian habitats within the Accomack Northampton Planning Region face multiple threats, primarily from water quality related issues.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Accomack Northampton planning region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's tidal creeks from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to prevent these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Kings Creek (DCR 2011), Mill Creek (Louis Berger 2012), and Occohannock Creek (DCR 2008) (Figure 8).

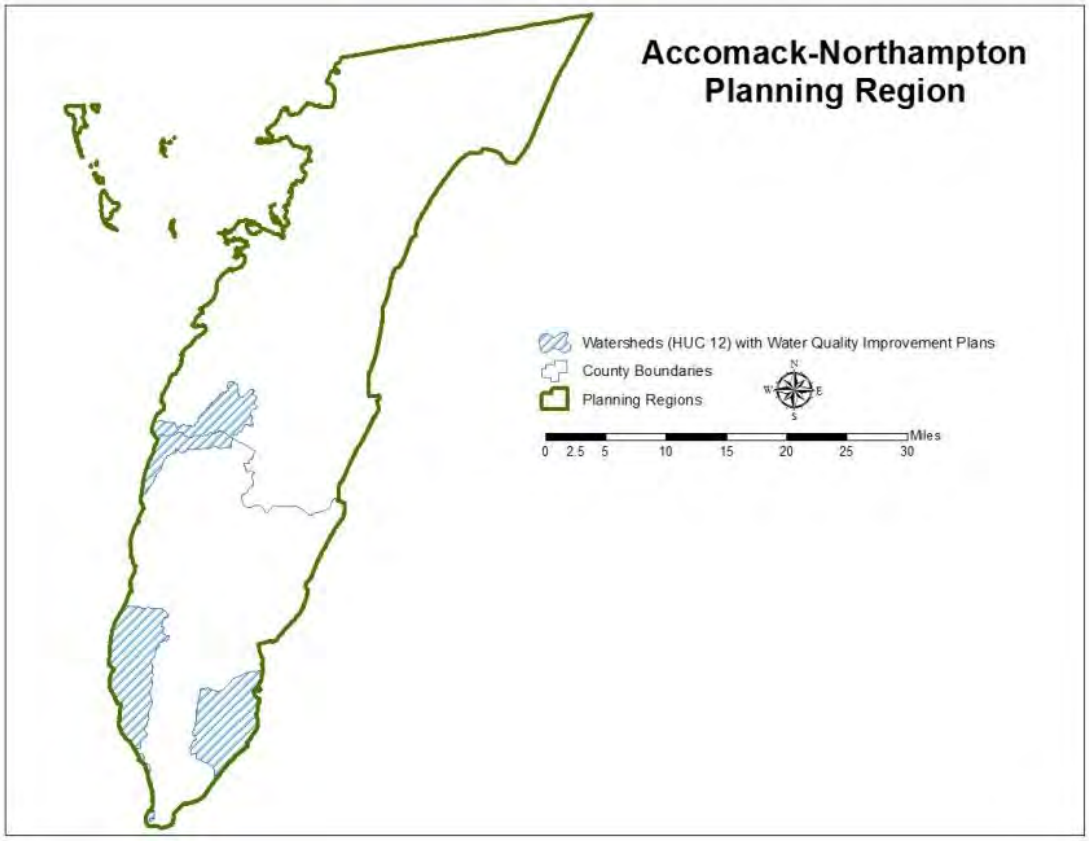

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing riparian vegetative buffers along waterways;
- Establishing waste storage facilities (such as dairy lagoons, or waste sheds) to better manage livestock waste and prevent flow into the river;
- Establishing retention ponds or features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands;
- Working with landowners to implement small acreage grazing systems;
- Repairing or replacing failing septic systems and pit privies; and
- Working to prevent pet waste from entering waterways and establishing a pet litter program to encourage owners to clean up pet waste.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

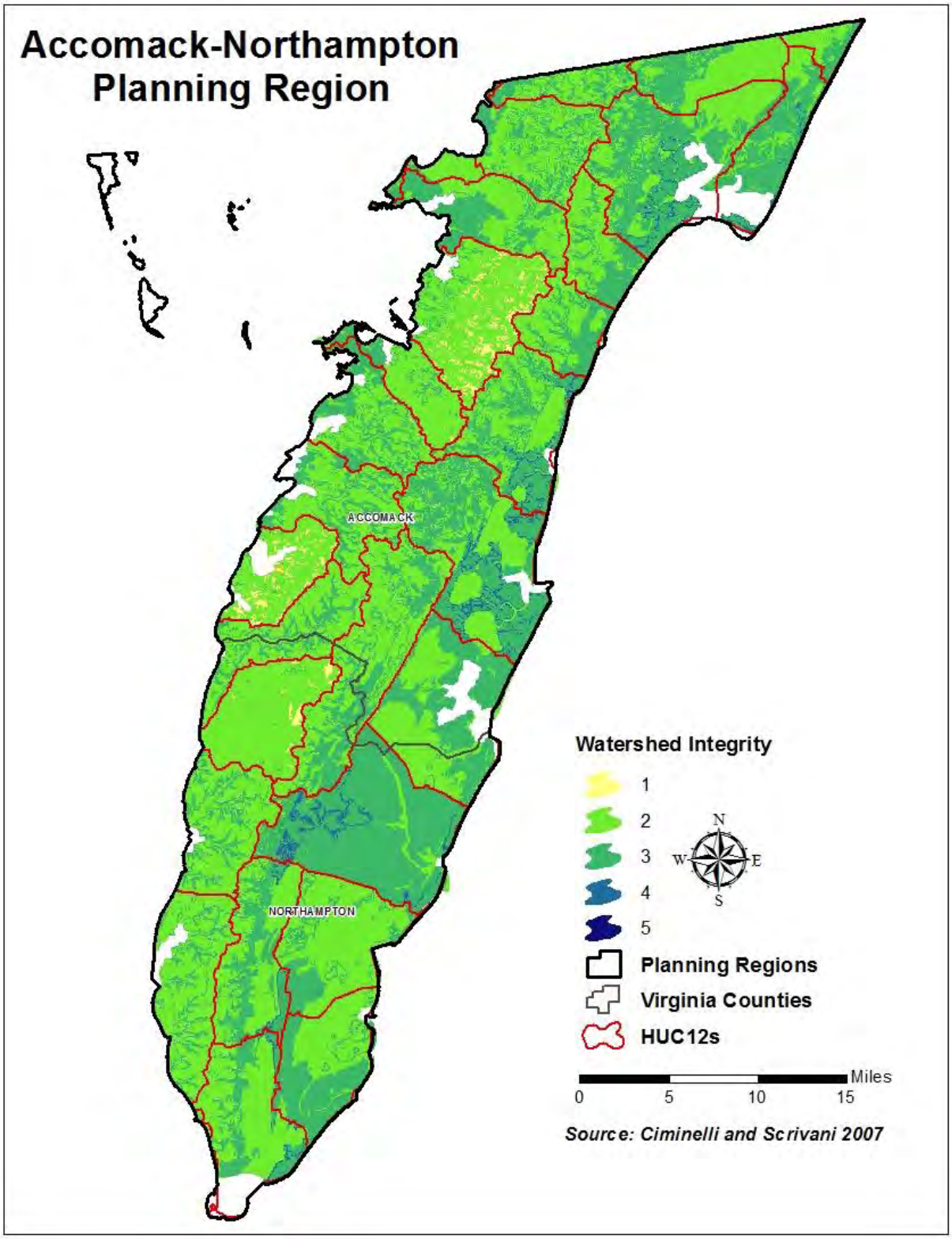

Figure 9. Watershed Integrity Model for Accomack Northampton Planning Region (Ciminelli and Scivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to prevent livestock waste from entering streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Accomack-Northampton Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

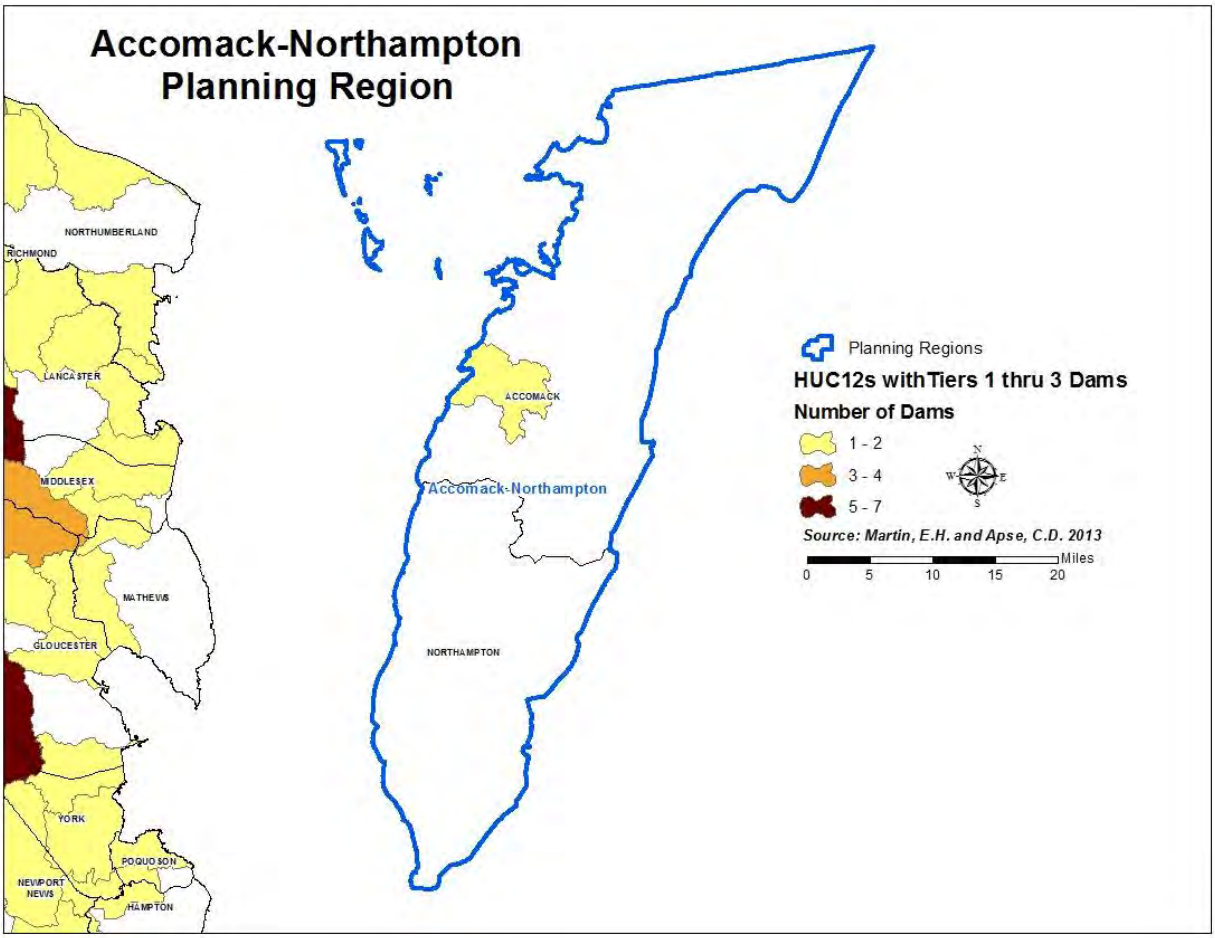

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Because sea-level rise will likely be an issue, native tree and shrub species that have a broader salinity tolerance should be considered. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests do not make up a large percentage of Accomack Northampton Planning Region; however, these habitats are important for a broad range of coastal forest species. Approximately 7.8 percent of the planning region is covered with mixed hardwood and conifer forests (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forest was likely referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources on the Peninsula and provide habitat for species such as the Delmarva fox squirrel, New Jersey chorus frog, Bicknell's thrush, Eastern wood-pewee, Eastern towhee, wood thrush, and migratory birds. The Eastern Shore also retains some of the best examples of the rare coastal plain maritime forests, which occur in small stands of stunted trees with contorted branches and dense vine layers that are often subject to salt spray, high winds, dune deposition, sand shifting, sand blasting, and occasional overwash (Anderson et al. 2013).

Table 5. Forest acreage totals in Accomack Northampton Planning Region (Anderson et al. 2013).

Forest Type	Acres	Percent of Planning Region
Mixed Hardwood and Conifer	47,111.67	7.82%

Threats

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests on the Eastern Shore is fragmentation, mainly due to residential development and resulting roads. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem on the Eastern Shore. Of particular note is the southern pine beetle. Southern pine beetle infestations can cause extensive loss to pine trees. Loblolly, short leaf, and Virginia pine are the most affected species within Virginia (DOF 2014).

3. Climate Change: Climate change poses a significant threat to these forests. Sea-level rise and more intense storm events likely will not only inundate forested areas close to the coast, but may also result in significant salt spray and salt water intrusion into lower salinity areas. Climate change is also expected to affect precipitation regimes and result in warmer temperatures, potentially leading to more drought conditions that would be harmful to coastal forests.

4. Threats to Rare Maritime Forest Stands: Stands of both North Atlantic and Central Atlantic maritime forests exist on the Eastern Shore; however, they are rare. In 2007, VIMS completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). The review of satellite imagery and field surveys indicates that only 1,389 acres of North Atlantic maritime forest and 2,704 acres of Central Atlantic maritime forest can be found on the Eastern Shore. This report also notes that over 88 percent of the remaining North Atlantic coastal plain maritime forests and 100 percent of Central Atlantic maritime forests occur on conserved lands. As the majority of this forest type exists on protected lands, there are no immediate threats to their persistence; however, during the coming decades, these rare forest stands will likely be threatened by climate change, including sea-level rise and the threat of increasing storm intensity and frequency (Berman and Berquist 2007). As beaches and dunes migrate, it is unclear what actions, if any, can be taken to facilitate the health and persistence of these rare forest patches.

Conservation Management Actions

Actions for conserving mixed hardwood conifer forests in Virginia's Eastern Shore may include working to conserve, either through acquisition, easement, cooperative management, or incentives, remaining intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to, using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent their spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (USFWS 2014).

For forests in the southern tip of the Accomack Northampton planning region, specifically in the Eastern Shore of Virginia NWR, managers focus forestry conservation actions on providing dense understories with adequate fruit and insect resources for neotropical and temperate migratory bird species as this area is a critical stopover site (USFWS 2004). Small shrubland areas are managed for the same purpose. The NWR is also working to acquire additional surrounding lands, including forested areas (USFWS 2004).

The Delmarva fox squirrel occurs in more northern portions of the planning region, in Chincoteague NWR and on Assateague Island. Forests are being managed for diversity of mature pine and hardwood

forests with understories that are somewhat open, trees that bear seeds and nuts, and mature trees with hollow cavities (USFWS 2014). Management involves prescribed burns and thinning (USFWS 2014).

It will be extremely important to maintain the quality of habitats on lands that have already been conserved. Second, the conservation community may pursue opportunities to conserve other forest patches either through acquisition, easement, or agreement. Priority areas could include forest patches that buffer or expand conserved lands. Virginia has also been working with NASA Wallops Flight Facility, The Nature Conservancy, researchers, and other partners to track night-migrating birds using high frequency radar. If specific areas are determined to be important roosting and foraging areas, working to conserve and enhance their habitat value would also be a priority.

Climate-Smart Management Actions

To best manage forests on the Eastern Shore as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Sea-level rise, salt water intrusion, and salt spray are expected to become more significant as sea levels rise and storms become more intense. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers may want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Setting aside areas to allow for migration of remaining maritime forest habitat should also be considered. It will be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into

Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by

partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. On the Eastern Shore, priority conservation opportunities include:

- Protecting beaches, near and inshore waters, and barrier islands;
- Improving the quantity and quality of water in creeks and rivers through best management practices and water quality improvement mechanisms;
- Protecting and restoring coastal wetlands; and
- Conserving tracts of mature hardwood forests.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN ACCOMACK-NORTHAMPTON PLANNING REGION

Complete SGCN list for the Accomack-Northampton Planning Region (SGCN=79). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	c	New Jersey chorus frog	*Pseudacris kalmi*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American oystercatcher	*Haematopus palliatus*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird		II	a	Black skimmer	*Rynchops niger*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		III	a	Brant	*Branta bernicla*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	b	Clapper rail	*Rallus longirostris*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*

Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird	**ST**	I	a	Gull-billed tern	*Sterna nilotica*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Least tern	*Sterna antillarum*
Bird		II	a	Little blue heron	*Egretta caerulea*
Bird		IV	a	Marbled godwit	*Limosa fedoa*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird	**FTST**	III	a	Piping plover	*Charadrius melodus*
Bird		IV	c	Purple sandpiper	*Calidris maritima*
Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*
Bird		IV	a	Royal tern	*Sterna maxima*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		III	a	Saltmarsh sparrow	*Ammodramus caudacutus*
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird	**SE**	I	a	Wilson's plover	*Charadrius wilsonia*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*

Mammal		II	c	Delmarva fox squirrel	*Sciurus niger cinereus*
Mammal	FE	IV	b	Fin whale	*Balaenoptera physalus*
Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammal		IV	c	Harbor porpoise	*Phocoena phocoena*
Mammal	FE	I	b	Northern right whale	*Eubalaena glacialis*
Mammal	FE	IV	b	West Indian manatee	*Trichechus manatus latirostris*
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile	**FTSE**	I	b	Green Sea Turtle	*Chelonia mydas*
Reptile	**FESE**	I	a	Kemp's ridley sea turtle	*Lepidochelys kempii*
Reptile	**FESE**	I	c	Leatherback Sea Turtle	*Dermochelys coriacea*
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

6. Central Shenandoah Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

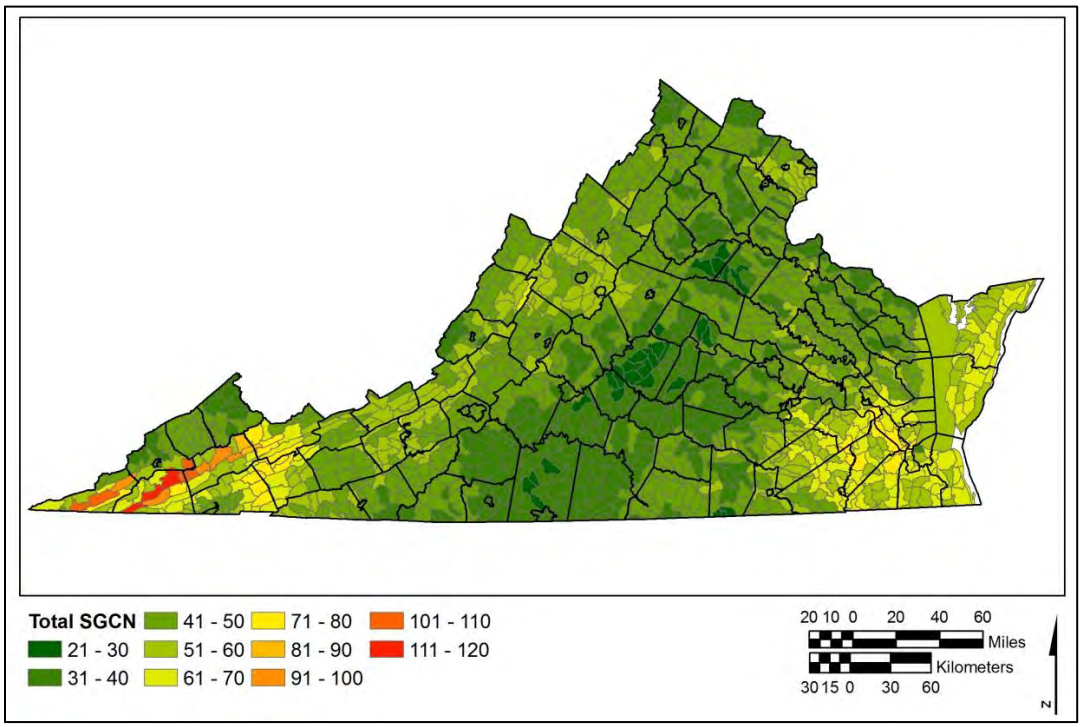

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

CENTRAL SHENANDOAH PLANNING REGION SUMMARY OVERVIEW

The Central Shenandoah Planning Region consists of 2,200,092 acres (3,438 square miles) and includes the counties of Augusta, Bath, Highland, Rockbridge, and Rockingham; cities of Buena Vista, Lexington, Harrisonburg, Staunton, and Waynesboro; and towns of Broadway, Bridgewater, Craigsville, Dayton, Elkton, Glasgow, Goshen, Grottoes, Monterey, Mt. Crawford, and Timberville. The human population in this planning region is estimated to be over 293,000 people, and most populations are projected to increase within the planning region by 2030 (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or energy and other extractive uses expand. This planning region contains a range of SGCN, including 28 SGCN that have 100 percent of their distribution within planning region. Many other SGCN such as mussels, amphipods, isopods, fish, bird, and mammal species depend on a variety habitats within the planning region, such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

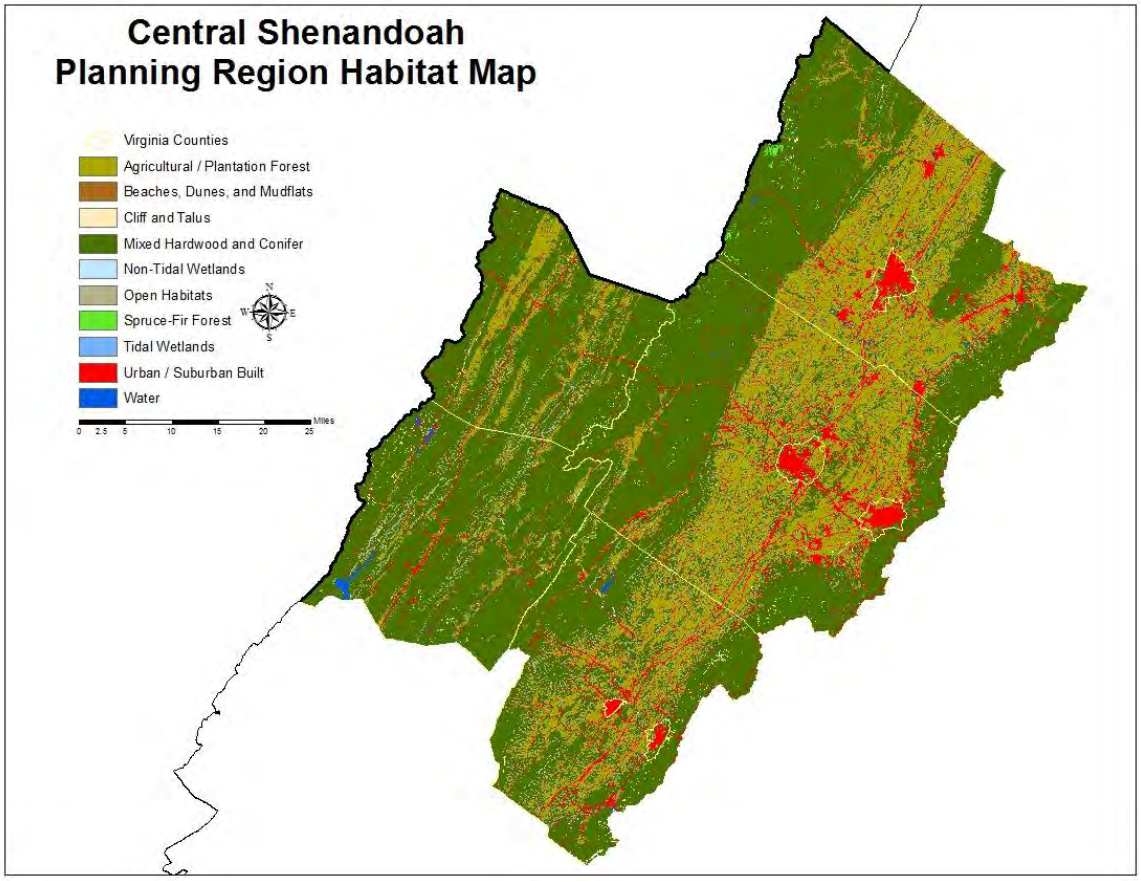

Figure 2. Central Shenandoah Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 120 are believed to either occur, or have recently occurred, within the Central Shenandoah Planning Region (Appendix A). Of these 121 species, ***97 SGCN are dependent upon habitats provided within the Central Shenandoah Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 96 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species

that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	8
Ib	5
Ic	10
IIa	3
IIb	2
IIc	23
IIIa	8
IIIb	1
IIIc	6
IVa	17
IVb	8
IVc	6

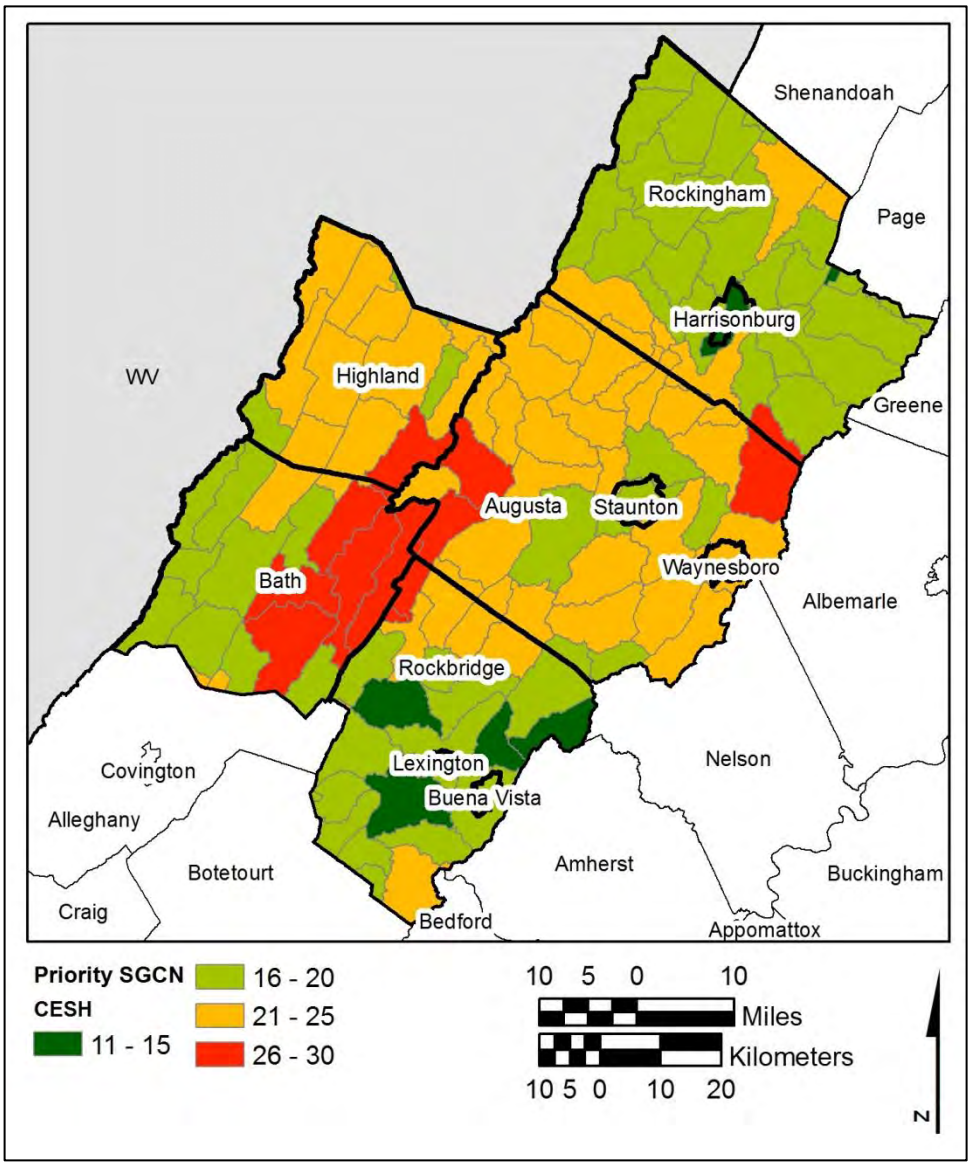

Figure 3. Priority SGCN Density in the Central Shenandoah Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within the Central Shenandoah Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		I	c	Cow Knob salamander	*Plethodon punctatus*	Site specific - mixed hardwood forests in rocky areas in high elevations
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*	Site specific pine savanna
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*	West of Shenandoah River - high elevation hardwood forests
Amphibian	**FS**	I	c	Peaks of Otter salamander	*Plethodon hubrichti*	Site specific - utilizing various forest, rhododendron thickets, and forested talus slopes with deep moist soils
Amphibian		III	c	Shenandoah Mountain salamander	*Plethodon virginia*	Site specific - deciduous hardwood forests on mountain slopes and ravines in western Rockingham County
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth.
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.

Bird		IV	a	Dunlin	*Calidris alpina hudsonia*	Winter resident shorelines and estuaries
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*	Open shrubby habitat (ex. old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		III	a	Northern bobwhite quail	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Bird		III	c	Red crossbill	*Loxia curvirostra*	Spruce-fir or hemlock forests above 4000 feet

Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*	Clean flowing streams with rocky substrates
Crustacean	**FS**	II	c	Bath County cave amphipod	*Stygobromus mundus*	Caves with clean abundant water flowing through the system
Crustacean		II	c	Blue crayfish	*Cambarus monongalensis*	Burrowing species that utilizes wooded hillsides with springs and seeps
Crustacean	**FS**	II	c	Burnsville Cove cave amphipod	*Stygobromus conradi*	Caves with clean abundant water flowing through the system
Crustacean	**FSST**	I	b	Madison Cave amphipod	*Stygobromus stegerorum*	Caves with clean abundant water flowing through the system
Crustacean	**FTST**	II	c	Madison Cave isopod	*Antrolana lira*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	II	c	Morrison's cave amphipod	*Stygobromus morrisoni*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	II	c	Rockbridge County cave amphipod	*Stygobromus baroodyi*	Caves with clean abundant water flowing through the system
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*	Pools of small creeks and rivers with sand or gravel substrate
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish		III	a	Notched rainbow	*Villosa constricta*	Clean streams with stable banks and sand or gravel substrates
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*	Clear medium sized streams with moderate current
Fish		IV	c	Slimy sculpin	*Cottus cognatus*	Spring fed cold water streams

FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*	Springs and cave streams in the Potomac basin and along the Blue Ridge
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*	Clear flowing water with sand or gravel substrates
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*	Clear flowing water with sand, gravel, or cobble substrates
FW Mollusk	**FSSE**	I	c	Rubble coil	*Helicodiscus lirellus*	Known from two rubble piles at the bases of two hills in Rockbridge county
FW Mollusk	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*	Known from four locations and occupies leaf litter at the base of limestone/shale outcropings
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*	Clean streams with stable banks and sand or gravel substrates
FW Mollusk		I	b	Virginia pigtoe	*Lexingtonia subplana*	Site specific - cool clean headwater streams with sand and gravel substrates
FW Mollusk	**FSSE**	I	a	Virginia springsnail	*Fontigens morrisoni*	Site specific caves and springs in Bath and Highland counties
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil
Insect	**FS**	II	c	Avernus cave beetle	*Pseudanophthalmus avernus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Crossroads Cave beetle	*Pseudanophthalmus intersectus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Maureen's shale stream beetle	*Hydraena maureenae*	The known habitat is a shale bottom Appalachian stream. This species apparently prefers the margins of clear mountain streams, adults sometimes occur on submerged vegetation, but occur mostly among sand grains.
Insect	**FS**	II	c	Mud-dwelling cave beetle	*Pseudanophthalmus limicola*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Natural Bridge cave beetle	*Pseudanophthalmus pontis*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens oak Savanna and other open sunny habitats
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*	Glades and prairie remnants
Insect		II	c	South Branch Valley cave beetle	*Pseudanophthalmus potomaca potomaca*	Caves with clean abundant water flowing through the system

Mammal		IV	c	Allegheny woodrat	*Neotoma magister*	Blue Ridge to the west - cliffs dry rocky slopes, talus, and exposed ridges
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*	High elevation forested areas west of the Shenandoah River
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred, though sometimes deeper locations are used. Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*	Blue Ridge to the west - rock piles, rock slides and cliffs surrounded by forests
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests
Mammal	**SE**	I	c	Snowshoe hare	*Lepus americanus virginianus*	Specific spruce/ fir sites in Highland county that provide sufficient cover.
Mammal	**SE**	II	c	Southern rock vole	*Microtus chrotorrhinus*	High elevation riparian areas
Mammal	**SE**	II	b	Southern water shrew	*Sorex palustris*	High elevation riparian areas in Bath and Highland counties
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*	Caves typically in limestone karst regions dominated by mature hardwood forests of hickory, beech, maple, and hemlock. Prefers cool, well-ventilated caves for hibernation; roost sites are often near cave entrances or in places where there is considerable air movement.
Mammal	**FESE**	I	c	Virginia northern flying squirrel	*Glaucomys sabrinus fuscus*	Spruce -fir and mixed conifer-northern hardwood forests
Other Aquatic Invertebrate	**FS**	I	c	Rockbridge County cave planarian	*Sphalloplana virginiana*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius anophthalmus*	Caves with clean abundant water flowing through the system

Other Terrestrial Invertebrate	**FS**	II	c	A cave spider	*Islandiana muma*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia alecto*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius coecus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius holsingeri*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Chitrella superba*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate		III	c	Depressed glyph	*Glyphyalinia virginica*	No habitats have been identified for this terrestrial snail
Other Terrestrial Invertebrate	**FS**	II	c	South Branch Valley cave millipede	*Pseudotremia princeps*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Talus coil	*Helicodiscus triodus*	No habitats have been identified for this species
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*	Permanent ponds, marshes, streams, and rivers, east of the Shenandoah river, with vegetated shorelines and amphibian and small fish populations
Reptile		II	c	Mountain earthsnake	*Virginia valeriae pulchra*	Forested portions of northwest Highland County
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*	Dry open slopes with cover and soils suitable for burrowing
Reptile		IV	a	Queen snake	*Regina septemvittata*	Crayfish obligate clear streams with rock or sandy bottoms and vegetated shorelines
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*	Moist meadows or grassy areas at the edges of bogs or small streams
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*	Barren
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*	Clear streams with adjacent riparian forests and fields

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Central Shenandoah Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national parks and national forests to state parks and state wildlife management areas to conservation easements. Significant conservation assets, in terms of size, include:

- George Washington and Jefferson National Forests,
- Shenandoah National Park,
- Blue Ridge Parkway,
- Skyline Drive,
- Goshen-Little North Mountain Wildlife Management Area,
- Highland Wildlife Management Area,
- T.M. Gathright Wildlife Management Area,
- Short Hills Wildlife Management Area,
- Lake Roberston Wildlife Management Area,
- Douthat State Park,
- Goshen State Natural Area Preserve,
- Deep Run Ponds Natural Area Preserve, and
- Warm Springs Mountain TNC Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

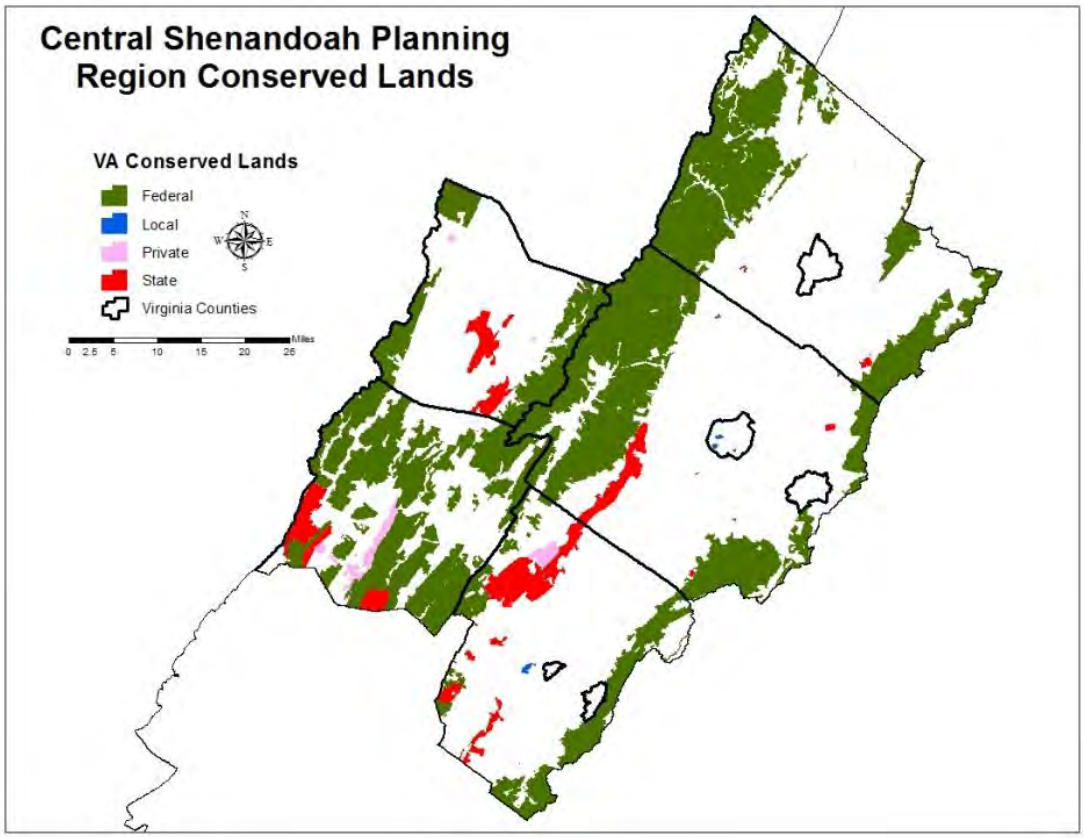

Figure 4. Conservation Lands in the Central Shenandoah Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Central Shenandoah Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting more lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the specific benefits and drawbacks of these lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Central Shenandoah Planning Region

Changes in temperature and precipitation will likely affect habitats and SCGN in the Central Shenandoah Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008

Climate Action Plan project that average temperatures will increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in at higher elevations than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Pepin 2015; Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson, 2011; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke, et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species' reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the Central Shenandoah Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Central Shenandoah Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Central Shenandoah Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Increasing industrial/residential water consumption, sedimentation and pollutants, protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watersheds with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated and/ or forested buffers along streams and sinkholes; 2) Reforest erodible pastures; 3) Exclude livestock from streams and areas around sinkholes; 4) Improve pasture and loafing lot management to prevent tainted runoff; 5) Implement conservation tillage; 6) Establish storage facilities for animal waste and runoff retention ponds;7) Prevent erosion after timber harvests; 8) Repair or replace failing septic systems and "straight pipes;" 9) Establish rain gardens;10) Sweep streets; 11) Stabilize dirt roads; 12) Reclaim abandoned mine lands;13) Work to prevent pet waste from entering the watershed; 14) Continue to identify impaired waters within the planning region; 15) Restore aquatic connections; 16) Monitor and address invasive species impacts; and 17) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, exotic and non-native invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Blacks Run, Cooks Creek, Buffalo Creek, Cedar Creek, Colliers Creek, Christians Creek, South River, Hays Creek, Moffatts Creek, Walker Creek, Otts Creek, Holman's Creek, Jennings Branch, Middle River, Polecat Draft, Moffett Creek, Linville Creek, Long Glade Run, Mossy Creek, Naked Creek, Long Meadow Run, Turley Creek, Dry River, Mill Creek, Muddy Creek, Pleasant Run, Smith Creek

Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Central Shenandoah Planning Region contains cave/karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for the Bath County cave amphipod, Madison cave amphipod, crossroads cave beetle, Natural Bridge cave beetle, and a variety of other species. Other species such as the Indiana bat depend on karst habitat and are endangered throughout their range. Caves in the planning region provide crucial winter habitat for some bat species.

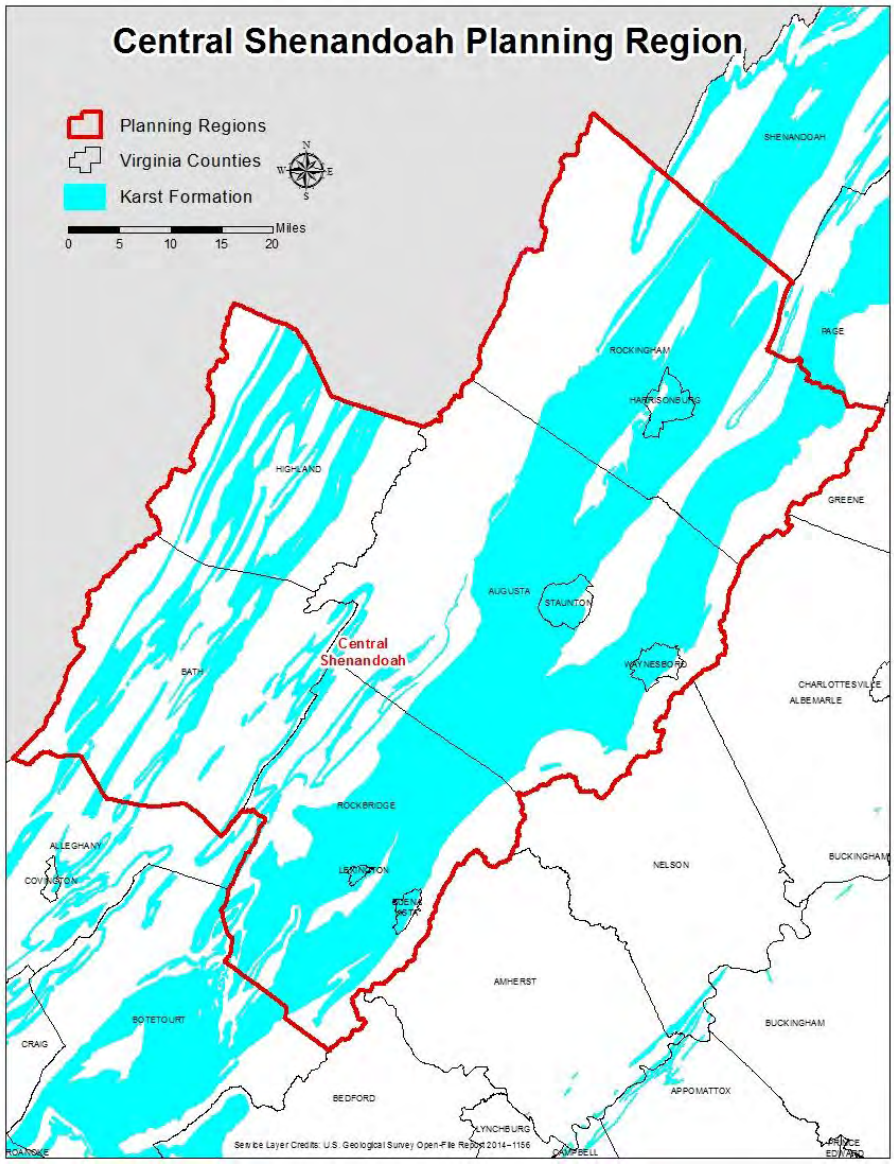

Figure 2. Karst Areas in the Central Shenandoah Planning Region (Geary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst system is affected by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites. Development and resulting pollutant-laden runoff also negatively affect water quality (DCR 2008).

2. Altered Hydrology: Development, which also likely plays a role in degraded water quality in the areas where karst occurs, can also result in altered hydrology which can affect water quantity and flows. The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to preserve the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Plants that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface will be even more important under climate change as with increased storm intensity will result in even more stormwater runoff.

Maintain and Restore Wetland Habitats

A very small percentage of the Central Shenandoah Planning Region is considered wetland habitat. Non-tidal wetlands make up approximately 0.15 percent (3,360 acres) of the planning region (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for the rusty blackbird, green heron, common ribbon snake, and a variety of other species.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP_ are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that result in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation. Examples of invasive species affecting these non-tidal wetlands include Japanese stilt grass and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Central Shenandoah Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Central Shenandoah Planning Region include those wetlands that allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 6) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). The highest priority wetlands for conservation are primarily adjacent to Shenandoah National Park and George Washington National Forest. The highest priority areas for restoration appear primarily in the Shenandoah Valley.

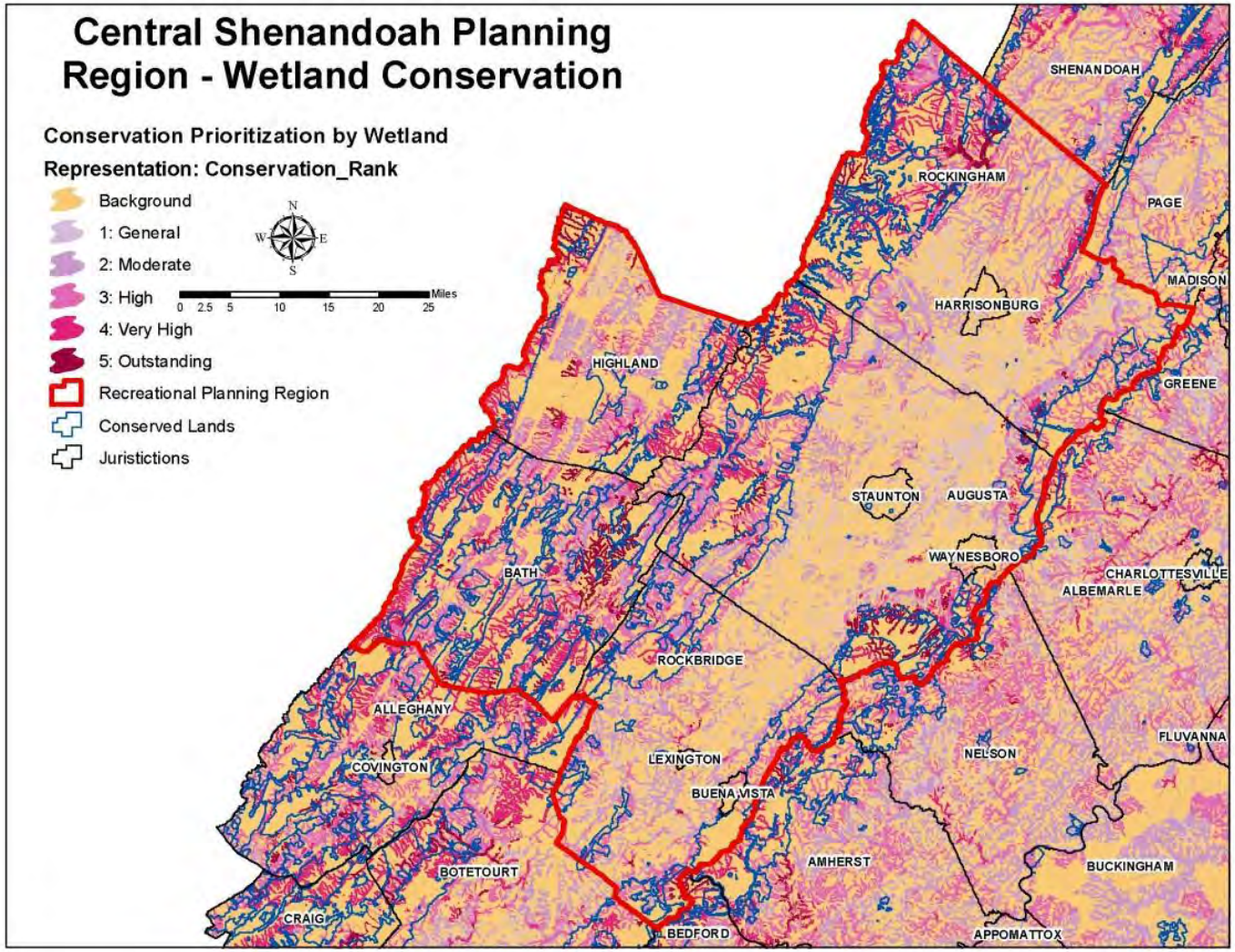

Figure 6. Wetland Conservation Priority Areas in Central Shenandoah Planning Region (Weber and Bulluck 2014).

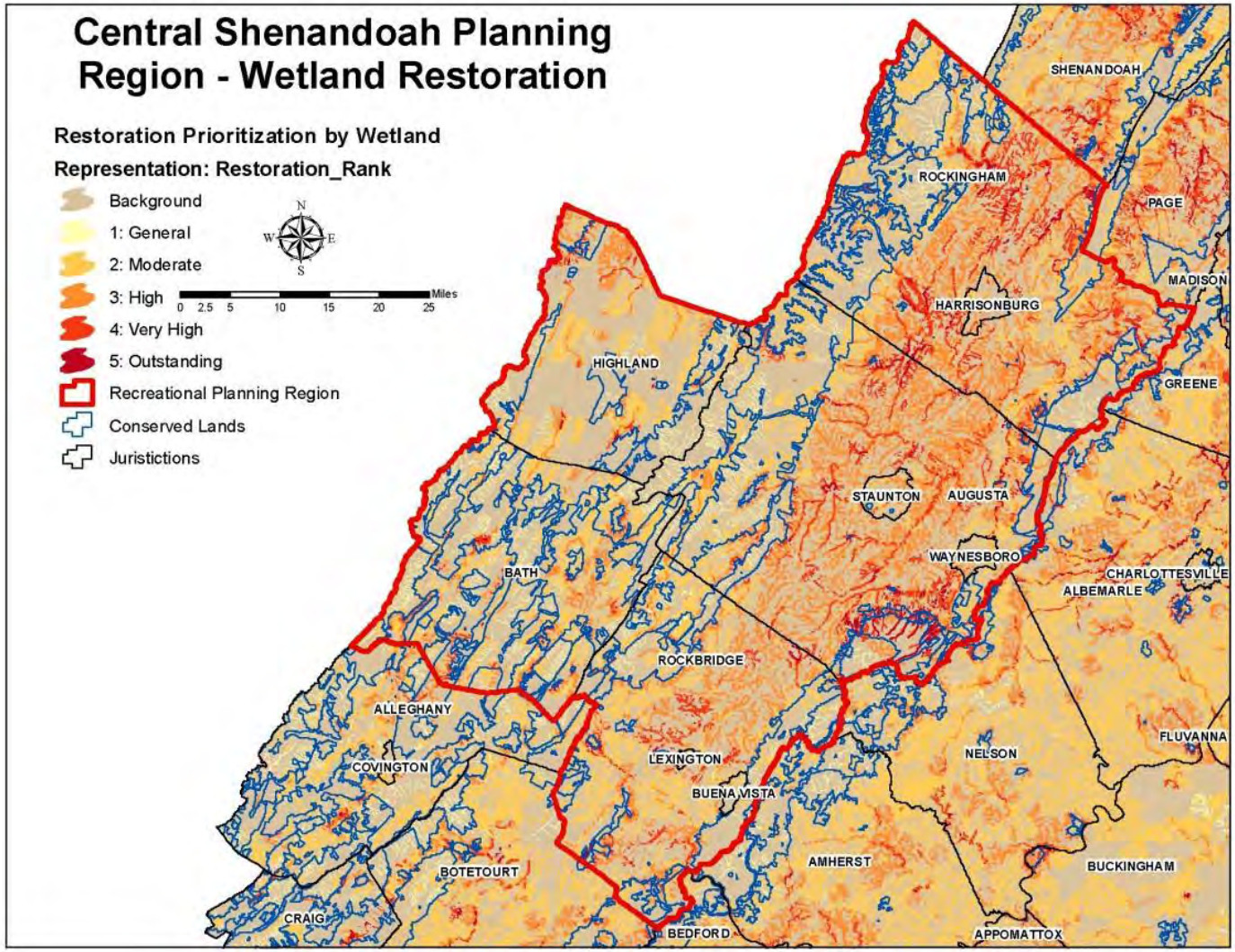

Figure 7. Priority Wetland Restoration Areas in Central Shenandoah Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and enhancement of wetlands by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Central Shenandoah Planning Region include cold and warm water rivers, streams, and creeks. Much of the planning region is within the Shenandoah River watershed. Approximately 10,000 acres (0.46 percent) of the planning region are considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the Virginia pigtoe, slimy sculpin, roughhead shine, pearl dace, brook trout, brook floater, Blue Ridge springsnail, and James spinymussel.

Threats

Aquatic and riparian habitats within the Central Shenandoah Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Central Shenandoah Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although much of the Central Shenandoah Planning Region has a low percentage of impervious surface cover, there is a larger percentage of impervious surface cover around population centers (Figure 8).

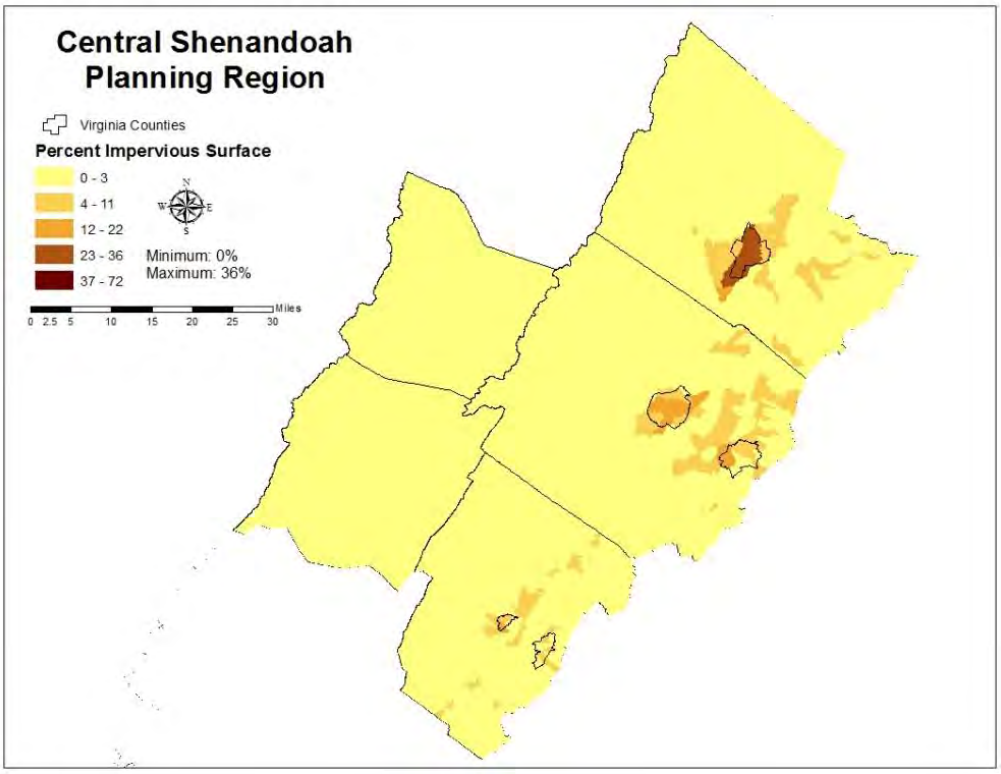

Figure 8. Impervious Surface Cover in Central Shenandoah Planning Region (SARP 2014).

3. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

4. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

5. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species, such as brook trout (Webb 2014).

6. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and air temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Blacks Run and Cooks Creek (DCR 2006); Buffalo Creek, Cedar Creek, and Colliers Creek (DEQ 2014); Christians Creek and South River (DCR 2010a); Hays Creek, Moffatts Creek, Walker Creek, and Otts Creek (DCR 2010b); Holman's Creek (DCR 2008); Jennings Branch, Middle River, Polecat Draft, and Moffett Creek (DCR 2009); Linville Creek (DCR 2013); Long Glade Run, Mossy Creek, Naked Creek (DEQ/DCR 2009); Long Meadow Run and Turley Creek (Virginia Tech and UVA 2012); Dry River, Mill Creek, Muddy Creek, and Pleasant Run (MapTech 2001); and Smith Creek (Virginia Tech 2009) (Figure 9).

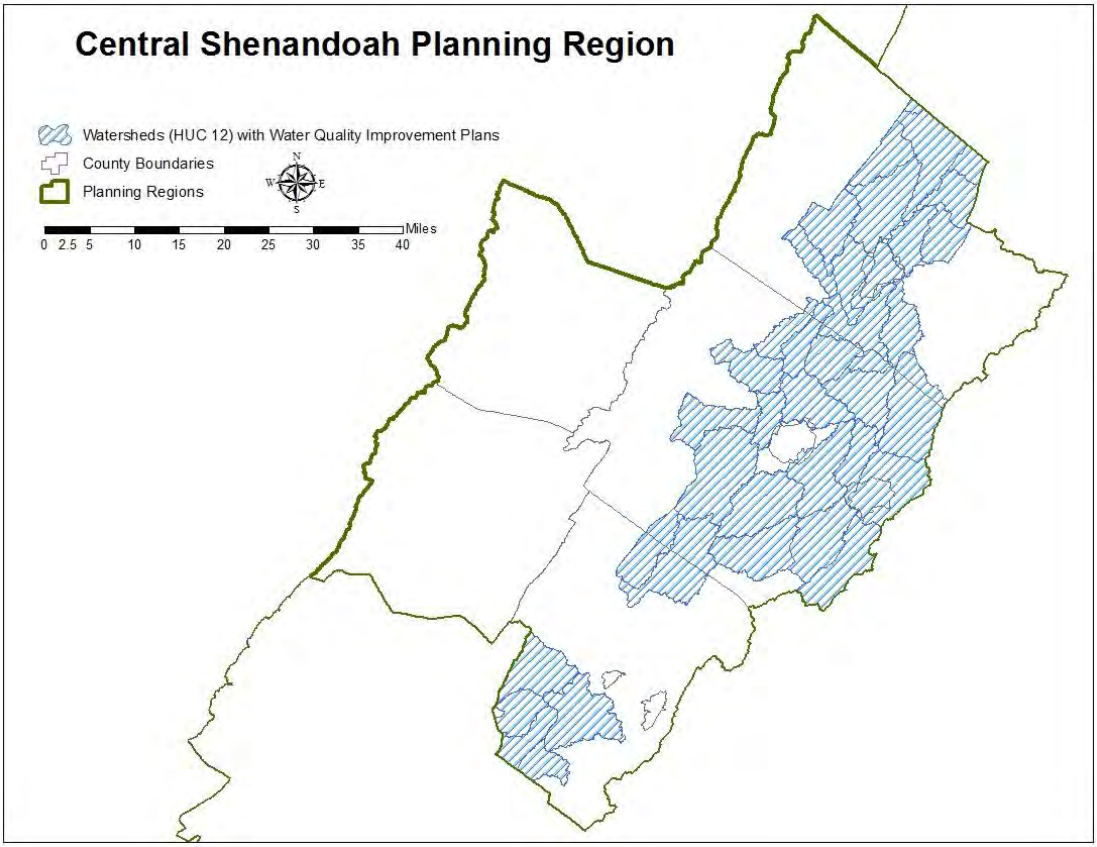

Figure 9. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated and/ or forested buffers along streams and sinkholes;
- Reforesting erodible pastures;

- Excluding livestock from streams and areas around sinkholes;
- Improving pasture and loafing lot management to prevent tainted runoff;
- Implementing conservation tillage;
- Establishing storage facilities for animal waste and runoff retention ponds;
- Preventing erosion after timber harvests;
- Repairing or replacing failing septic systems and “straight pipes” that deposit human waste into streams;
- Establishing rain gardens;
- Sweeping streets;
- Stabilizing dirt roads;
- Reclamation of abandoned mine lands; and
- Working to prevent pet waste from entering the watershed.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 10).

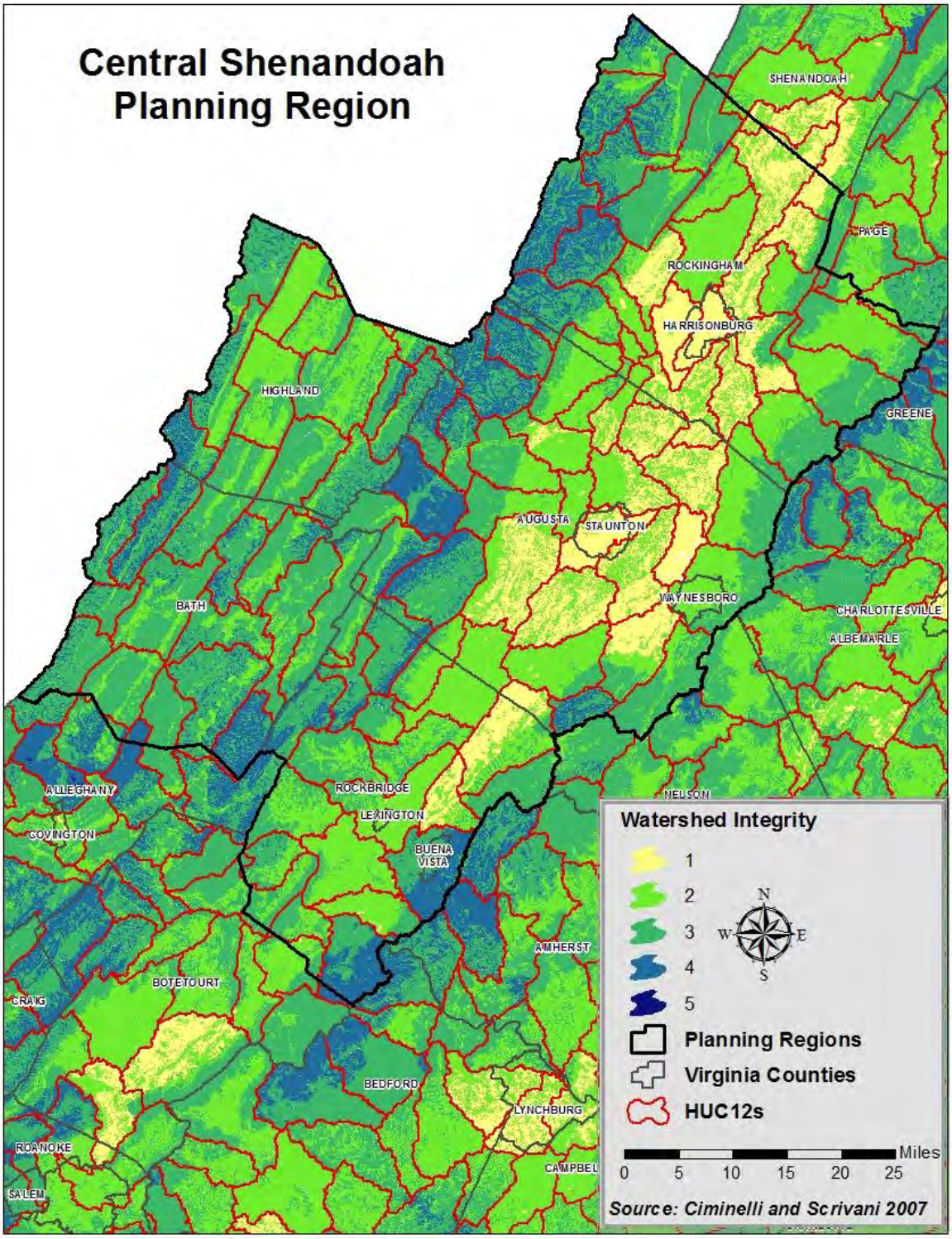

Figure 10. Watershed Integrity Model for Central Shenandoah Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Reducing impervious surface by replacing with more porous materials or vegetation;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Central Shenandoah Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Central Shenandoah Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost two thirds of the Central Shenandoah Planning Region and are important for a broad range of species (Table 4). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by

woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the Central Shenandoah Planning Region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods (oak and hickory) and conifers. These forests help protect water resources within the region and provide habitat for species such as the snowshoe hare, rock vole, mountain earthsnake, Virginia Northern flying squirrel, American woodcock, ruffed grouse, and American water shrew.

Table 4. Forest Acreage Totals in Central Shenandoah Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent Planning Region
Spruce Fir	3,070.66	0.14%
Mixed Hardwood and Conifer	1,380,577.38	62.75%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Central Shenandoah Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Energy development (wind energy and the potential for natural gas) could also degrade habitat and affect species composition and water quality.

2. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia have curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

3. Acid Rain: Although acid rain is less prevalent today than it once was, residual effects to the water and soil still remain and can affect forest health.

4. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note are the hemlock wooly adelgid and the gypsy moth, which has a significant effect on the ecology of oak-hickory forests (DOF 2014).

5. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates the deer population in Rockingham County needs to be reduced in order to meet a variety of social and

ecological goals (DGIF 2015a). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. In many cases, deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive species are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

6. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of spruce fir forests are already under some form of conservation) in the Central Shenandoah Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Hays, Moffatts, Walker, and Otts Creeks – A Plan to Reduce Bacteria in the Water* developed by DCR and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within Hays Creek, Moffatts Creek, Otts Creek, and Walker Creek watersheds to help decrease sediment run off as well as provide wildlife habitat (DCR 2010).

Several agencies, including DGIF, NRCS, DOF, USFWS and the USFS advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient

numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times within Virginia's current Deer Management Plan and will be similarly addressed in the revised 2015-2024 Deer Management Plan (DGIF 2015a). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Central Shenandoah Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens and make up approximately 80,045 acres (3.6 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. Within this planning region, glades and barrens are the primary open habitat present. These areas provide habitat for the golden winged warbler, loggerhead shrike, and persius duskywing.

Threats

Changing land use patterns has played a large role in the loss of open forests habitats as has the alteration of natural disturbance regimes.

1. Land Use Changes: Dozens of open forest species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Augusta County offers some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015b).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate)

	• Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within Central Shenandoah Planning Region, priority conservation opportunities include:

- Protecting karst habitats.

- Protecting the quantity and quality of water.
- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN CENTRAL SHENANDOAH PLANNING REGION

Complete SGCN list for the Central Shenandoah Planning Region (SGCN=120). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		I	c	Cow Knob salamander	*Plethodon punctatus*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Amphibian	**FS**	I	c	Peaks of Otter salamander	*Plethodon hubrichti*
Amphibian		III	c	Shenandoah Mountain salamander	*Plethodon virginia*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*

Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	c	Red crossbill (Type I)	*Loxia curvirostra*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*
Crustacean	**FS**	II	c	Bath County cave amphipod	*Stygobromus mundus*
Crustacean		II	c	Blue crayfish	*Cambarus monongalensis*
Crustacean		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Crustacean	**FESE**	II	a	Gray bat	*Myotis grisescens*
Crustacean	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Crustacean	**FSST**	I	b	Madison Cave amphipod	*Stygobromus stegerorum*
Crustacean	**FS**	II	c	Morrison's cave amphipod	*Stygobromus morrisoni*
Crustacean	**FS**	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*
Crustacean	**FS**	II	c	Rockbridge County cave amphipod	*Stygobromus baroodyi*
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*
Fish		IV	c	Slimy sculpin	*Cottus cognatus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*

FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		I	b	Virginia pigtoe	*Lexingtonia subplana*
FW Mollusk	**FSSE**	I	a	Virginia springsnail	*Fontigens morrisoni*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	II	c	Avernus cave beetle	*Pseudanophthalmus avernus*
Insect	**FS**	II	c	Crossroads Cave beetle	*Pseudanophthalmus intersectus*
Insect	**FS**	II	c	Maureen's shale stream beetle	*Hydraena maureenae*
Insect	**FS**	II	c	Mud-dwelling cave beetle	*Pseudanophthalmus limicola*
Insect	**FS**	II	c	Natural Bridge cave beetle	*Pseudanophthalmus pontis*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect		II	c	South Branch Valley cave beetle	*Pseudanophthalmus potomaca potomaca*
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**SE**	I	c	Snowshoe hare	*Lepus americanus virginianus*
Mammal	**SE**	II	c	Southern rock vole	*Microtus chrotorrhinus*
Mammal	**SE**	II	b	Southern water shrew	*Sorex palustris*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Mammal	**FESE**	I	c	Virginia northern flying squirrel	*Glaucomys sabrinus fuscus*
Other Aquatic Invertebrates	**FS**	I	c	Rockbridge County cave planarian	*Sphalloplana virginiana*
Other Terrestrial Invertebrates	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius anophthalmus*

Other Terrestrial Invertebrates	**FS**	II	c	A cave spider	*Islandiana muma*
Other Terrestrial Invertebrates	**FS**	II	c	A millipede	*Pseudotremia alecto*
Other Terrestrial Invertebrates	**FS**	II	c	Cave pseudoscorpion	*Apochthonius coecus*
Other Terrestrial Invertebrates	**FS**	II	c	Cave pseudoscorpion	*Chitrella superba*
Other Terrestrial Invertebrates	**FS**	II	c	Cave pseudoscorpion	*Apochthonius holsingeri*
Other Terrestrial Invertebrates		III	c	Depressed glyph	*Glyphyalinia virginica*
Other Terrestrial Invertebrates	**FSSE**	I	c	Rubble coil	*Helicodiscus lirellus*
Other Terrestrial Invertebrates	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*
Other Terrestrial Invertebrates	**FS**	II	c	South Branch Valley cave millipede	*Pseudotremia princeps*
Other Terrestrial Invertebrates	**FS**	II	c	Talus coil	*Helicodiscus triodus*
Other Terrestrial Invertebrates		III	c	Variable mantleslug	*Pallifera varia*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		II	c	Mountain earthsnake	*Virginia valeriae pulchra*
Reptile		I	b	Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	c	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

7. Commonwealth Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV- *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

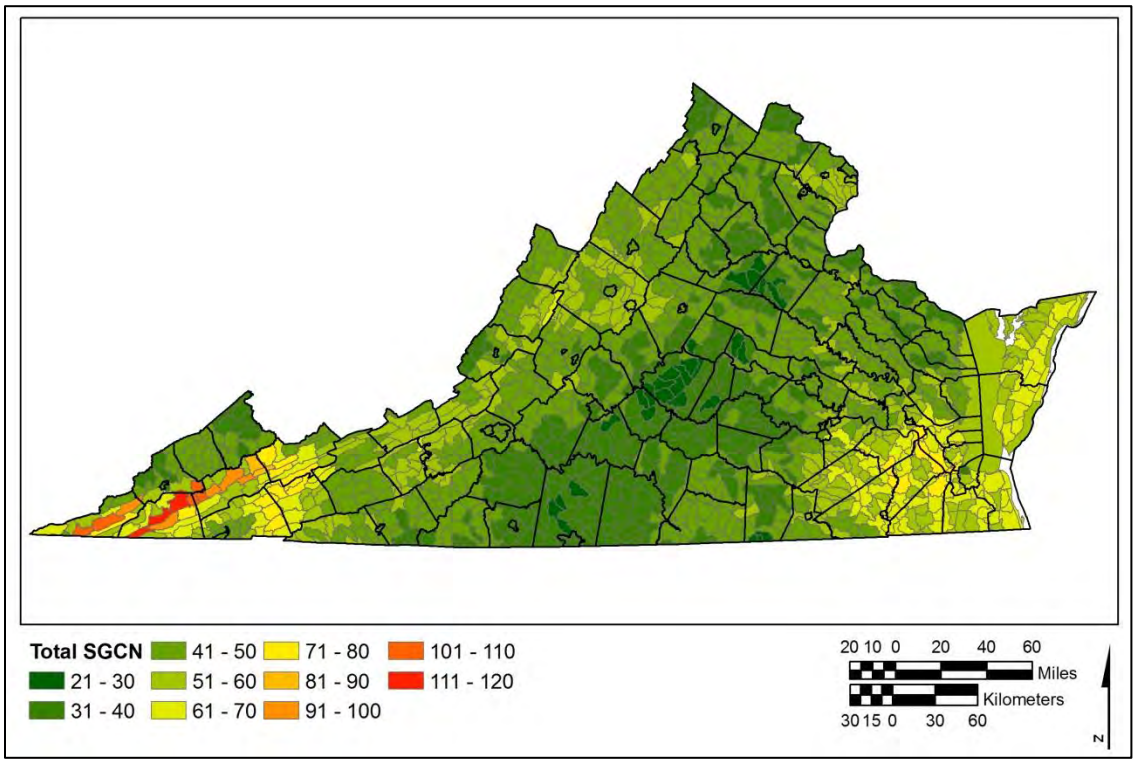

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

COMMONWEALTH REGIONAL PLANNING REGION SUMMARY OVERVIEW

The Commonwealth Regional Planning Region consists of 1,604,432 acres (2,507 square miles) and includes the counties of Amelia, Buckingham, Charlotte, Cumberland, Lunenburg, Nottoway, and Prince Edward. The area's human population is estimated to be approximately 103,000 (US Census Bureau 2015). All counties are projected to experience a slight increase in population size by 2030 (DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. This planning region is especially important to the conservation of the dotted skipper, Carolina darter, Roanoke slabshell, and Atlantic pigtoe, among other SGCN. It also includes a variety of habitats such as mature mixed hardwood forests, young forests, retired agricultural land, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

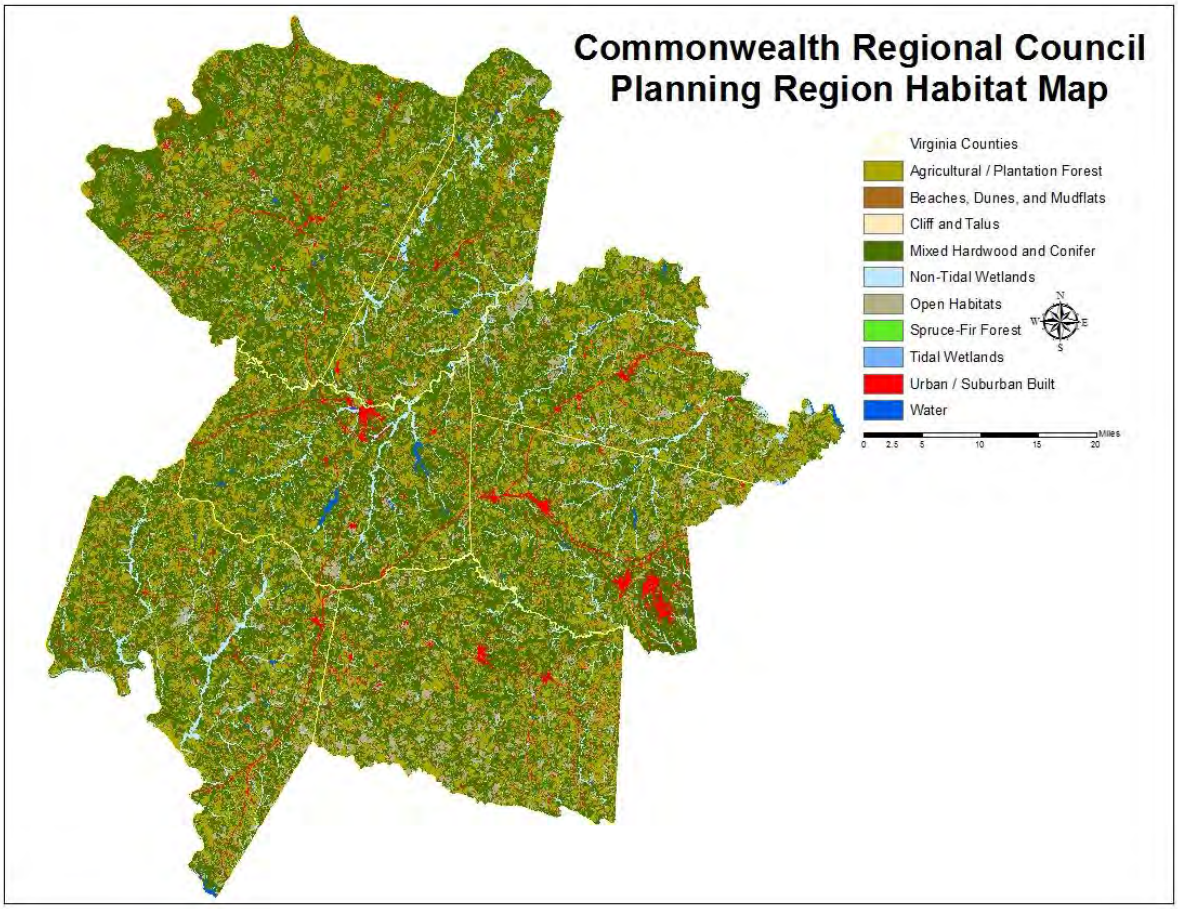

Figure 2. Commonwealth Regional Planning Region (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 86 are believed to either occur, or have recently occurred, within the Commonwealth Regional Planning Region (Appendix A). Of these 86 species, ***40 SGCN are dependent upon habitats provided within the Commonwealth Regional Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 40 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also

included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	4
IIa	2
IIb	1
IIc	4
IIIa	4
IIIb	1
IIIc	2
IVa	14
IVb	6
IVc	2

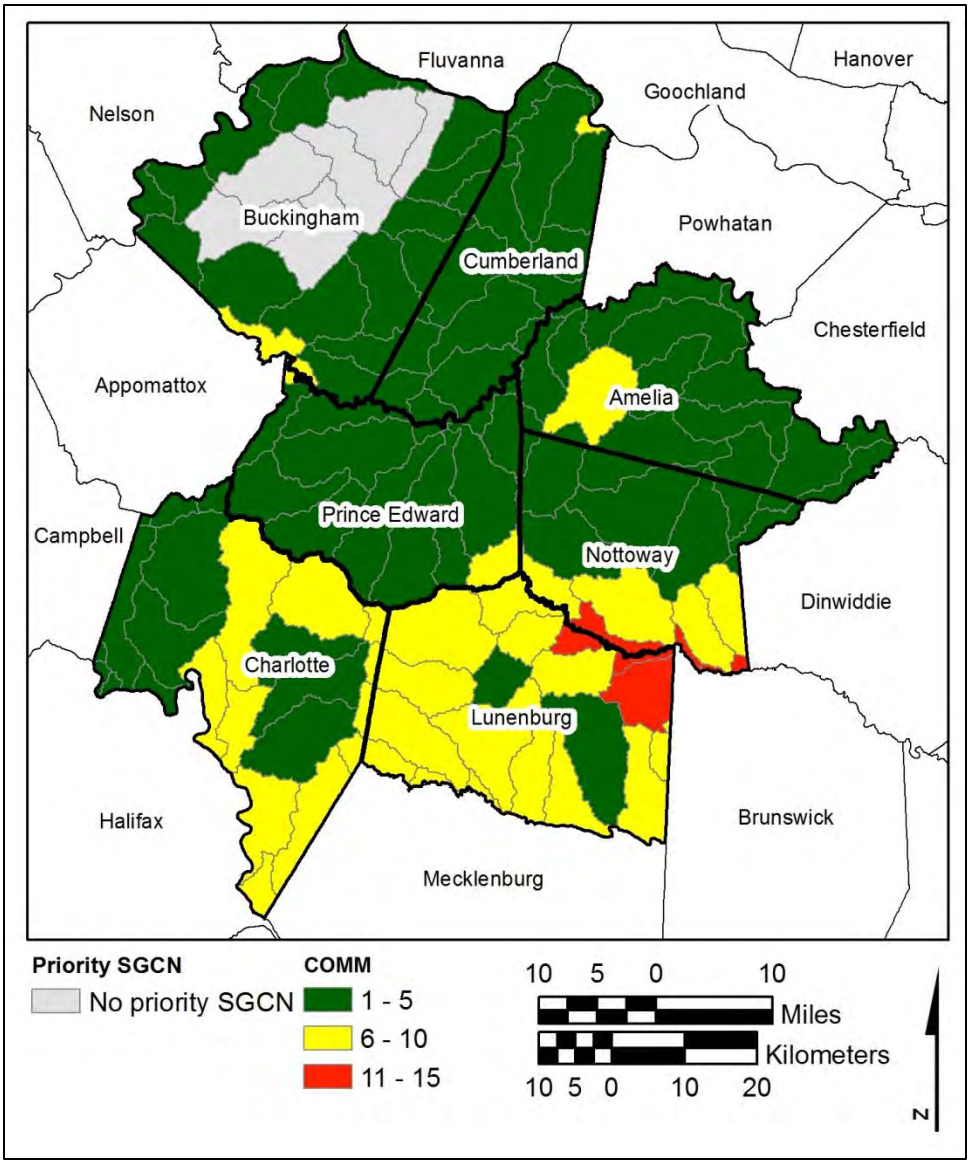

Figure 3. Priority SGCN Density in the Commonwealth Regional Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Commonwealth Regional Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	a	Greater siren	*Siren lacertina*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		II	a	Mole salamander	Ambystoma talpoideum	Hardwood and mixed forests containing fish-free breeding ponds
Bird	**ST**	I	a	Bachman's sparrow	*Peucaea aestivalis*	Pine savanna/ open pine woodlands
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association.

Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests.
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist .
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Fish		I	a	Bridle shiner	*Notropis bifrenatus*	Slow clear water with aquatic vegetation
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*	Very slow moving water with sand or gravel substrates flowing through wooded areas or pastures

Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*	Moderately acidic creeks, streams, and swamps
Fish		III	a	Notched rainbow	*Villosa constricta*	Clean streams with stable banks and sand or gravel substrates
Fish		IV	c	Speckled killifish	*Fundulus rathbuni*	Slow moving streams and creeks with sandy substrates
Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*	Clear to somewhat turbid creeks, with varying substrates
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*	Clean swift waters with stable gravel or sand/ gravel substrate
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	Usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*	Clean warm streams and rivers with low to moderate current and unsilted substrates
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*	Streams and rivers with high ground water content and good flow
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*	Deeper channels of relatively fast flowing rivers
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*	Clean streams with stable banks and sand or gravel substrates
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*	Large streams and rivers with low gradient and sand and gravel substrates
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*	Short grass prairies, pine barrens, and woodland meadows
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Auturus erythropygos*	No habitats have been identified for this species
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	Upland pine habitats
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*	Wetland generalist as long as aquatic salamanders are present
Reptile		III	c	Scarletsnake	*Cemophora coccinea copei*	Forest generalist but require soils suitable for digging

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FS), and Species of Collection Concern (CC).

Conserved Lands in the Commonwealth Regional Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks and forests to state wildlife management areas. Significant conservation assets, in terms of size, include:

- James River State Park,
- Bear Creek Lake State Park,
- Twin Lakes State Park,
- Appomattox-Buckingham State Forest,
- Cumberland State Forest,
- Amelia Wildlife Management Area,
- Horsepen Lake Wildlife Management Area, and
- Featherfin Farm Wildlife Management Area.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

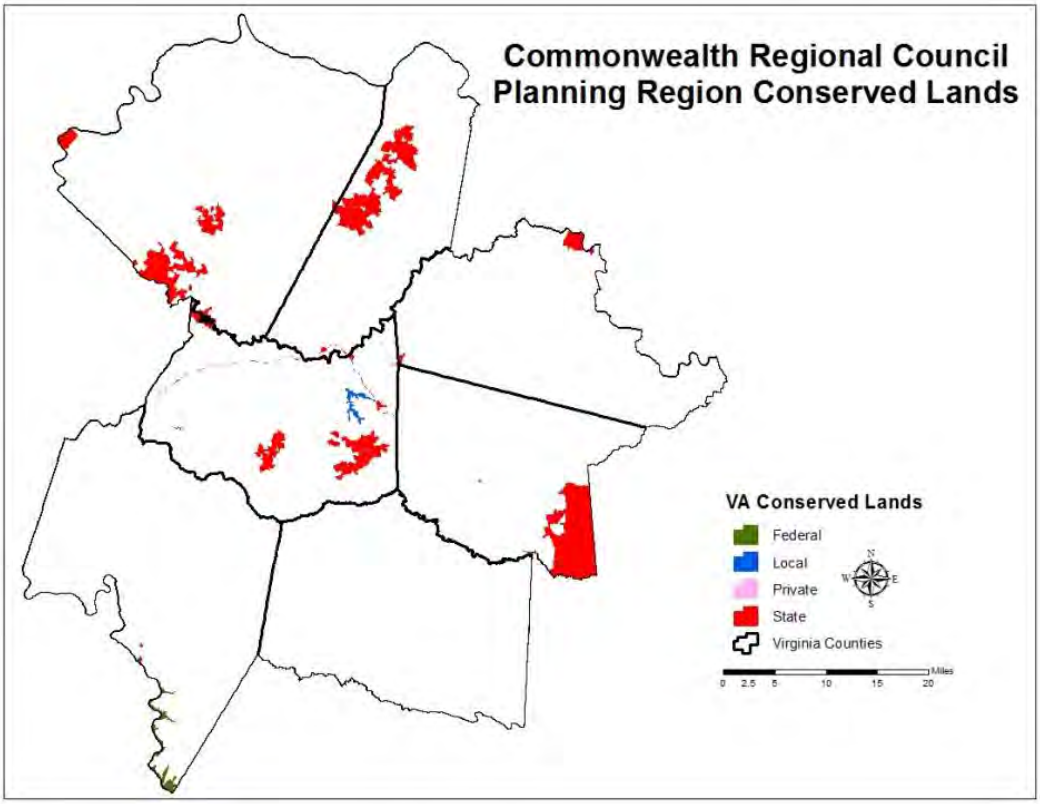

Figure 4. Conservation Lands in the Commonwealth Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Commonwealth Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting additional lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within this planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Commonwealth Planning Region

Increases and changes in temperature and precipitation will likely negatively affect habitats and SGCN in the Commonwealth Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). The models developed for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson, 2011; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke, et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the Commonwealth Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Commonwealth Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Commonwealth Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watersheds with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated or forested riparian buffers and incorporate riparian buffers into land use planning and management; 2)Reforest erodible pasture or croplands; 3) Utilize conservation tillage and cover crop techniques; 4) Establish rain gardens in appropriate sites; 5) Implement erosion and sediment control practices in urban areas; 6) Fence livestock out of streams and providing alternative water sources; 7) Improve pasture management; 8) Repair failing septic systems and eliminating "straight pipes;" 9) Work to prevent pet waste from entering the watershed; 10) Improve pasture and loafing lot management; 11) Develop improved methods for incorporating manure and other biosolids into soil; 12) Continue to identify impaired waters within the planning region; 13) Restore aquatic connections; 14) Monitor and address invasive species impacts; and 15) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Ash Camp Creek, Briery Creek, Buffalo Creek, Bush River, Cobb Creek, Deep Creek, Flat Creek, Little Sandy Creek, Nibbs Creek, Rock Island Creek, Saylers Creek, Slate River, Spring Creek, Turnip Creek, Twittys Creek, West Creek, Willis River

Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/ other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore of native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers	Pine savannas not already protected and open habitats that support SGCN

Maintain and Restore Wetland Habitats

A very small percentage of the Commonwealth Planning Region is wetland habitat. Non-tidal wetlands make up approximately 4.9 percent (88,336 acres) of the planning region (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for species like the rusty blackbird, mudsnake, and green heron.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that result in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation through direct consumption or outcompeting for resources. Examples of invasive species affecting these non-tidal wetlands include: purple loosestrife and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Commonwealth Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued

through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Commonwealth Planning Region include those wetlands that would allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5)(Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014).

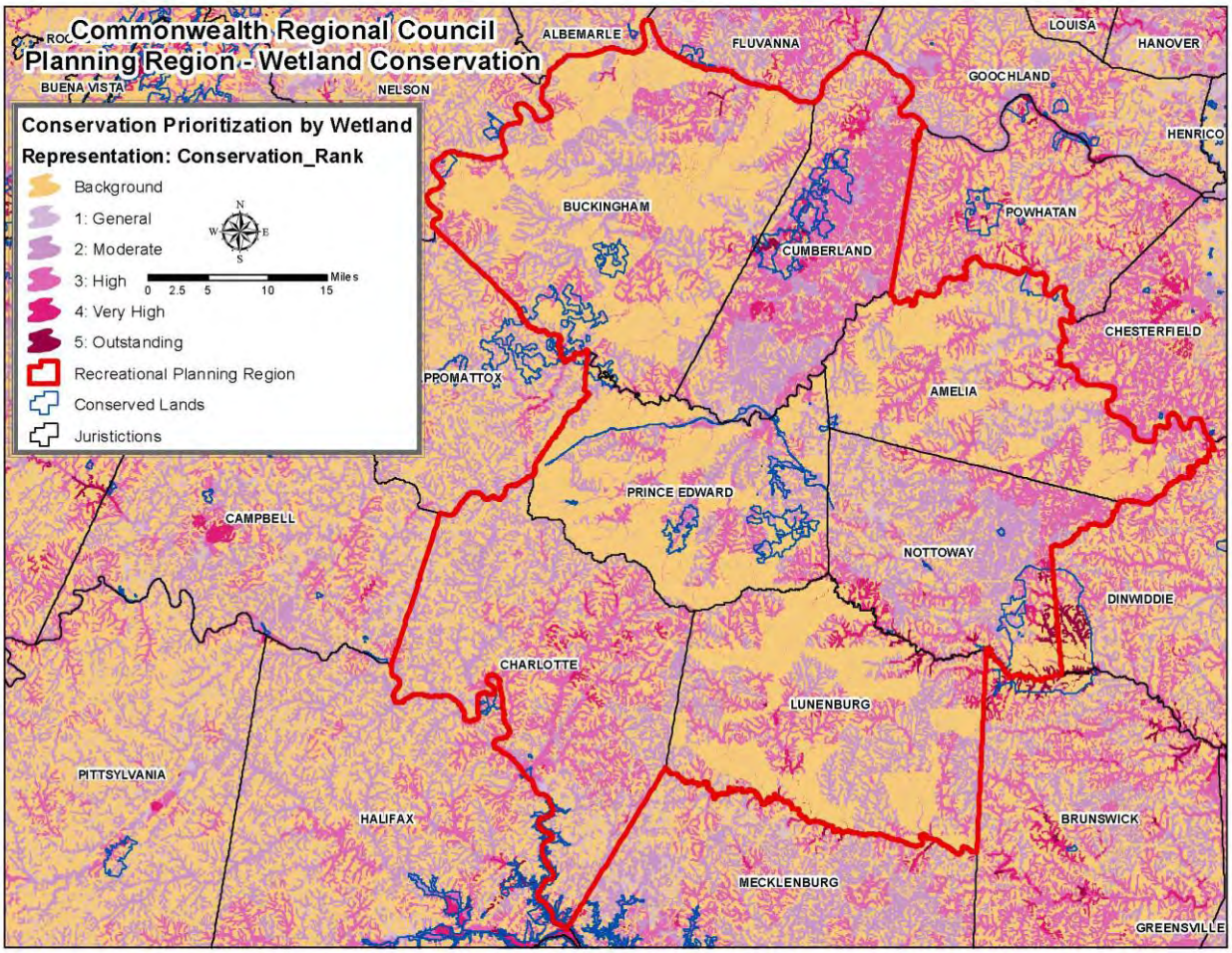

Figure 9. Wetland Conservation Priority Areas in Commonwealth Planning Region (Weber and Bulluck 2014).

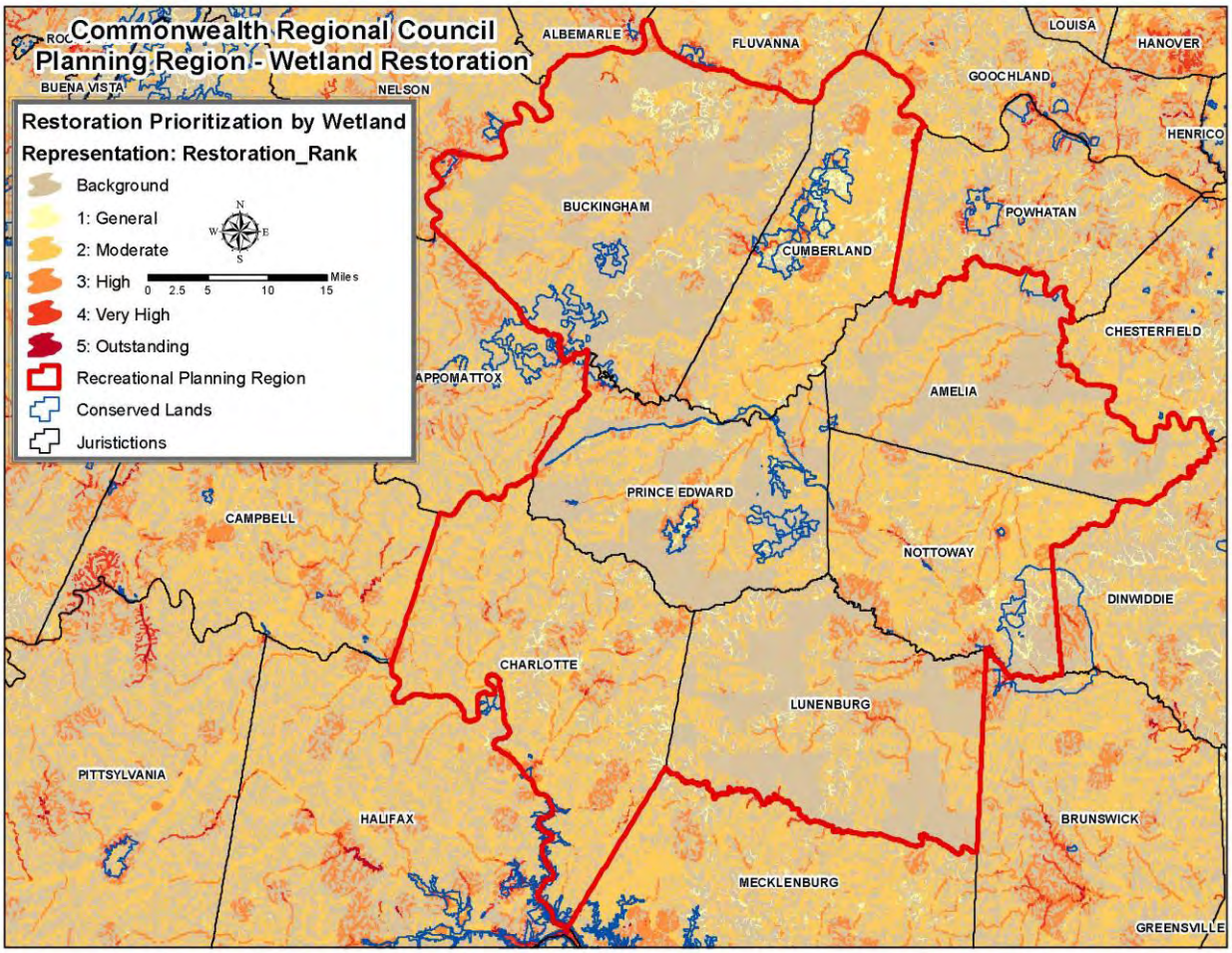

Figure 10. Wetland Restoration Priority Areas in Commonwealth Planning Region (Weber and Bulluck 2014).

Enhance, Maintain, and Restore Aquatic and Riparian Habitat

The Commonwealth Planning Region lies within the James River and Appomattox River watersheds. Approximately 15,000 acres (0.84 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include the Carolina darter, Roanoke slabshell, Atlantic pigtoe, bridle shiner, speckled killifish, and greater siren.

Threats

Aquatic and riparian habitats within the Commonwealth Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Commonwealth Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Most of the Commonwealth Planning Region has a low percentage of impervious surface cover (Figure 5).

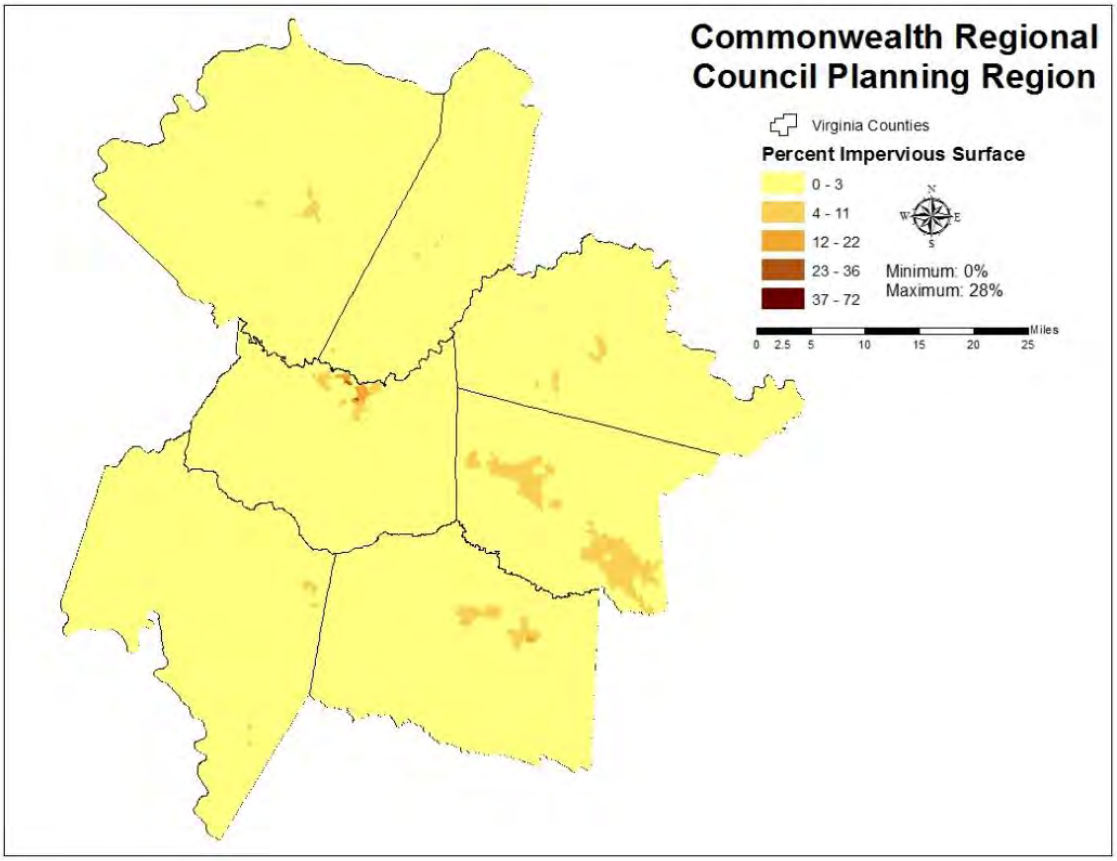

Figure 5. Impervious Surface Cover in Commonwealth Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Commonwealth Planning Region include invasive species such as hydrilla and nonnative crayfish that either consume native species or consume aquatic vegetation, thereby altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates.

6. Climate change: Climate change will likely affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone

summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Ash Camp Creek and Twittys Creek (DCR 2010), Briery Creek, Bush River, Saylers Creek, and Little Sandy Creek (MapTech 2008a), Buffalo Creek and Unnamed Tributary, Cub Creek, and Turnip Creek (MapTech 2009); Nibbs, Deep Creek, Flat Creek, and West Creek (MapTech 2008b); Rock Island Creek and Slate River (Blue Ridge Environmental Solutions 2010); and Willis River (MapTech 2005) (Figure 6).

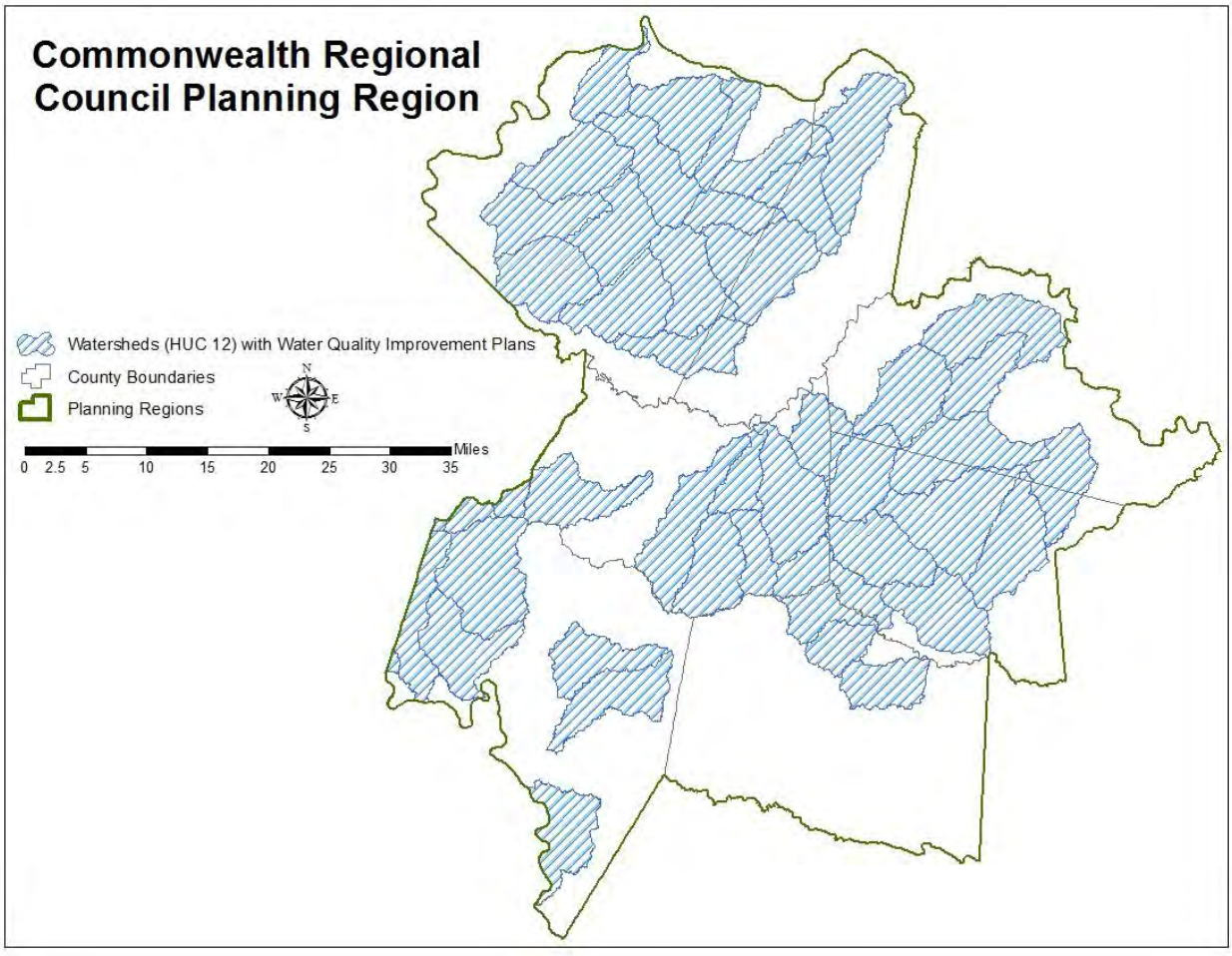

Figure 6. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated or forested riparian buffers and incorporating riparian buffers into land use planning and management;
- Reforesting erodible pasture or croplands;
- Utilizing conservation tillage and cover crop techniques;
- Establishing rain gardens in appropriate sites;
- Implementing erosion and sediment control practices in urban areas;
- Fencing livestock out of streams and providing alternative water sources;
- Improving pasture management;
- Improving pasture and loafing lot management to prevent manure-tainted water from flowing into streams;
- Developing improved methods for incorporating manure and other biosolids into soil;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams; and
- Working to prevent pet waste from entering the watershed.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 7).

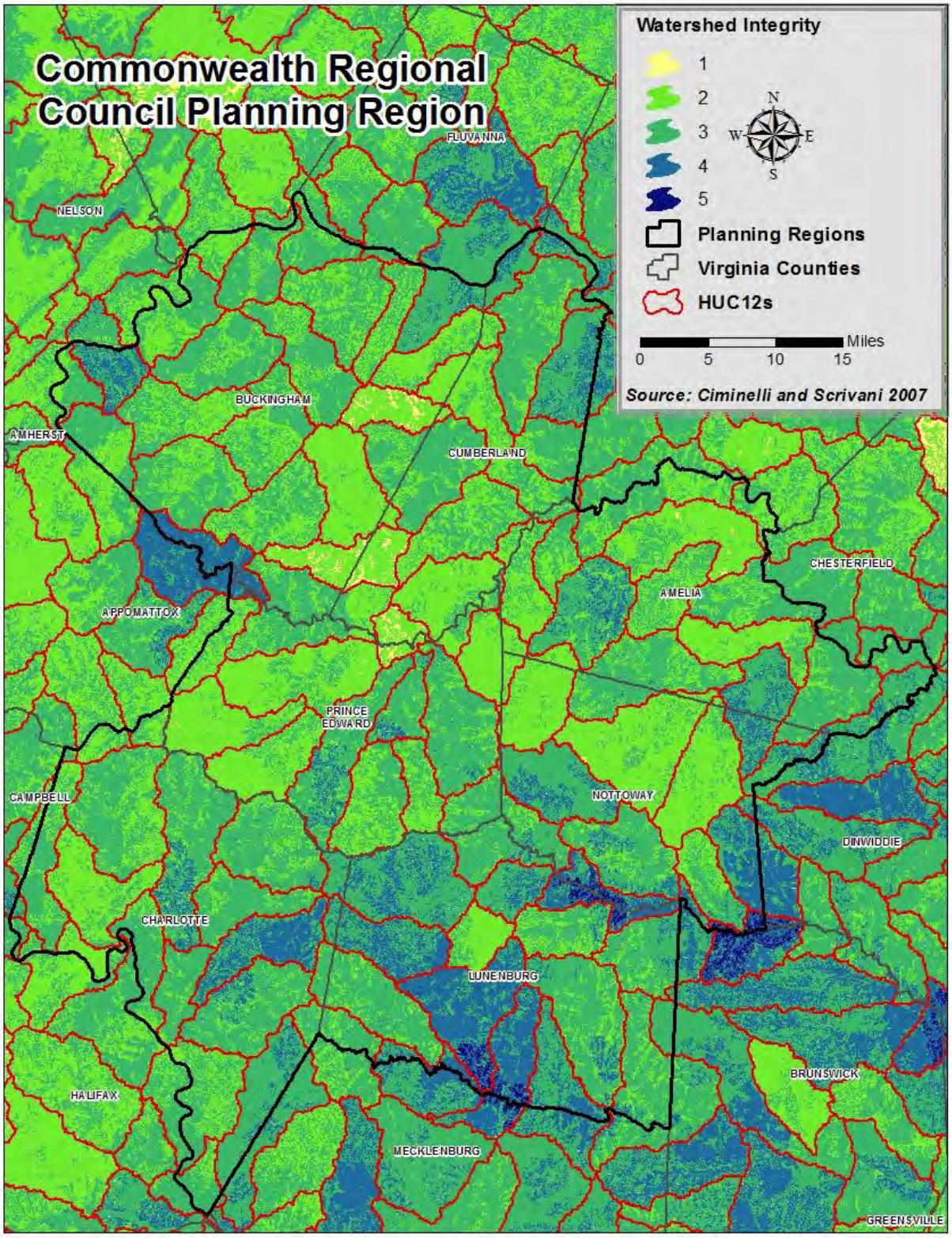

Figure 7. Watershed Integrity Model for Commonwealth Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Commonwealth Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities,, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 8) (Martin and Apse 2013).

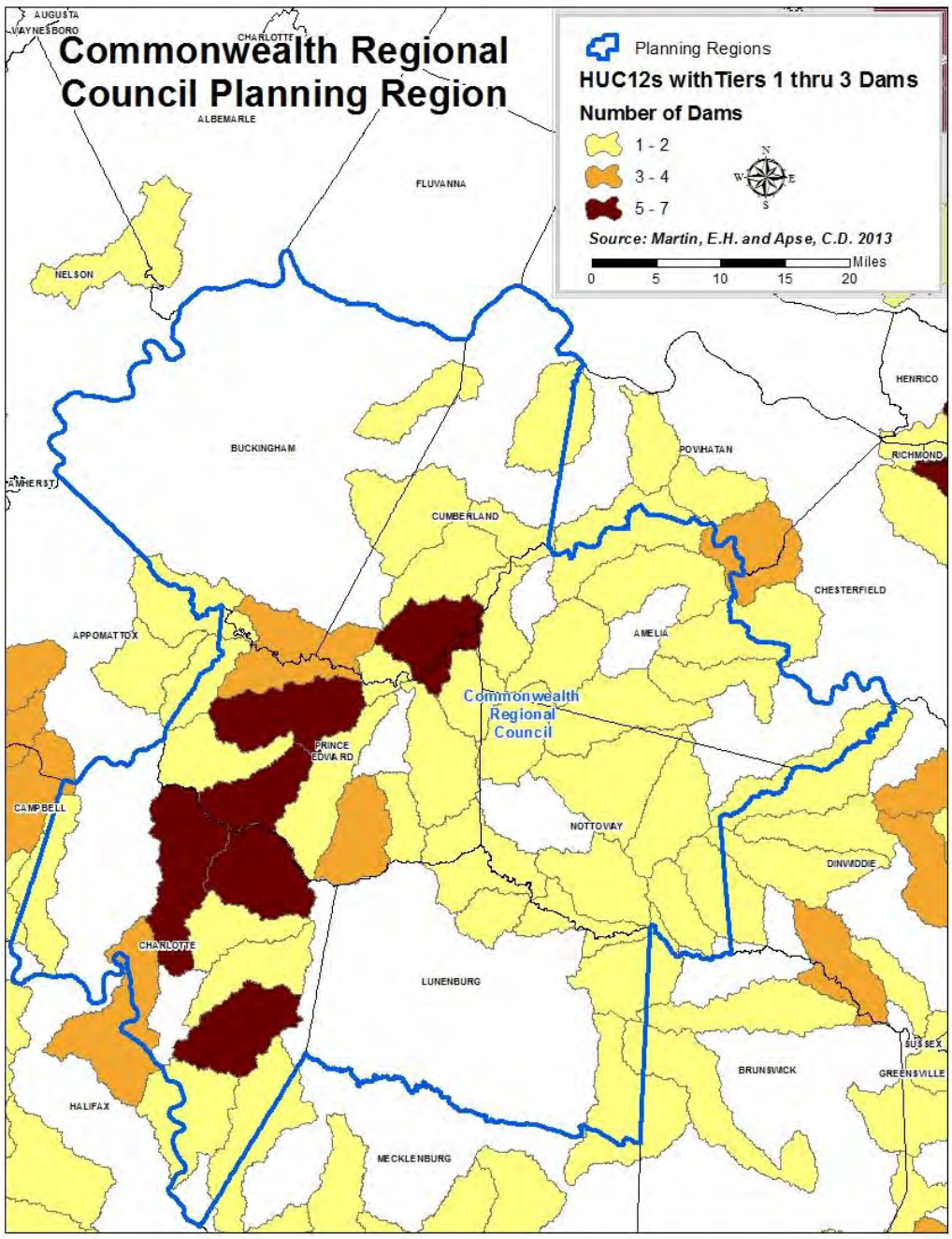

Figure 8. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Commonwealth Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions, easements, or agreements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up over half of Commonwealth Planning Region and are important for a broad range of species (Table 4). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the northern scarletsnake, Eastern whip-poor-will, and Kentucky warbler, and yellow-bellied cuckoo, among others.

Table 4. Forest Acreage Totals in Commonwealth Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	961,562.76	53.20%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Commonwealth Planning Region is fragmentation, mainly due to expanding development and resulting roads. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher air temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Commonwealth Planning Region may include working with willing landowners to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The P*lan to Reduce Sediment Loading in Ash Camp Creek and Twittys Creek Watersheds, Charlotte County, Virginia* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Ash Camp Creek and Twittys Creek watersheds to help decrease sediment run off as well as provide wildlife habitat (DCR 2010). Other watersheds have similar recommendations, including Buffalo Creek, Turnip Creek and Cub Creek (DCR 2009), Rock Island Creek, and Slate River (Blue Ridge Environmental Solutions 2010).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Commonwealth Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SGCN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures, drought, and other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests.

Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, wildlife managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, glades, barrens, and young forests. In this planning region approximately 143,810 acres (8 percent) of the planning region is considered open habitat (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection, such as the Eastern kingbird, Eastern meadowlark, Eastern whip-poor-will, and field sparrow, among other species.

Threats

Changing land use patterns have played a large role in the loss of open and young forests habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH, inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

For existing open habitats, specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). NRCS provides landowners with other opportunities including the Conservation Reserve Program and the Environmental Quality Incentives Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in this planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Commonwealth Planning Region, priority conservation opportunities include:

- Improving the quality and quantity of water in creeks and rivers through best management practices and water quality improvement mechanisms;
- Conserving tracts of mature hardwood and conifer forests; and
- Maintain and restore open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN COMMONWEALTH PLANNING REGION

Complete SGCN list for the Commonwealth Planning Region (SGCN=86). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		III	a	Dwarf waterdog	*Necturus punctatus*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird	**ST**	I	a	Bachman's sparrow	*Aimophila aestivalis*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*

Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish		IV	c	Speckled killifish	*Fundulus rathbuni*
Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*

FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Other Terr Invert	**FS**	II	c	A millipede	*Auturus erythropygos*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

8. Crater Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Recreation Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on applicable conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

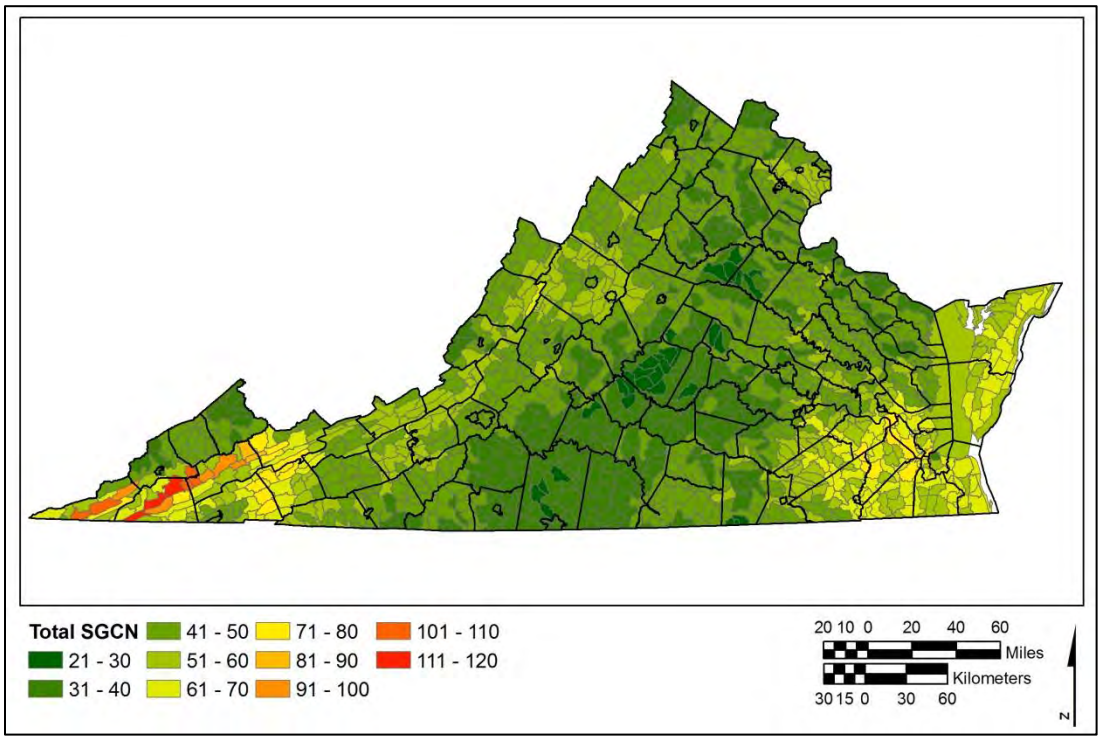

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions (DCR 2013). Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

CRATER LOCAL PLANNING REGION SUMMARY OVERVIEW

The Crater Planning Region consists of 1,653,478 acres (2,584 square miles) and includes the counties of Dinwiddie, Greensville, Prince George, Surry, and Sussex and cities of Colonial Heights, Emporia, Hopewell, and Petersburg. The human population in this planning region is estimated to be almost 174,000 people (U.S. Census Bureau 2015). These counties are projected to experience slight population growth by 2030 (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. This planning region is especially important to the conservation of red cockaded woodpecker found within pine savanna habitat. This savanna habitat is also important to Bachman's sparrow and southern chorus frog, among other species. The region's blackwater systems support a broad range of SGCN such as the blackbanded sunfish, dwarf waterdog, and toplined minnow. Mature pine forest habitat supports the southeastern fox squirrel. The region also includes a variety of other habitat types such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, and tidally influenced streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

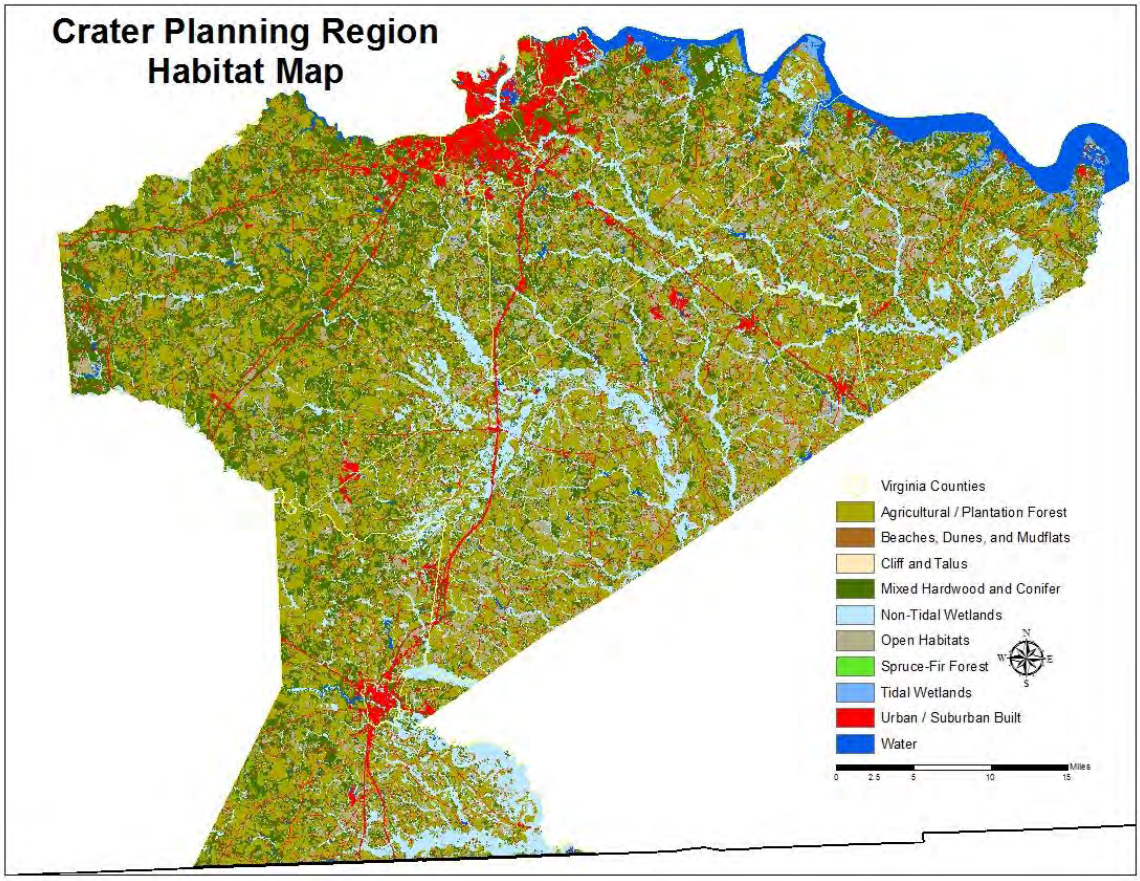

Figure 2. Crater Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 106 are believed to either occur, or have recently occurred, within the Crater Planning Region (Appendix A). Of these 106 species, ***73 SGCN are dependent upon habitats provided within the Crater Planning Region (Table 2). These species constitute the priority SGCN for the planning region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1 while Figure 3 demonstrates the density of the 73 priority species within this planning region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	9
Ib	1
IIa	4
IIb	1
IIc	2
IIIa	8
IIIb	3
IIIc	3
IVa	21
IVb	9
IVc	12

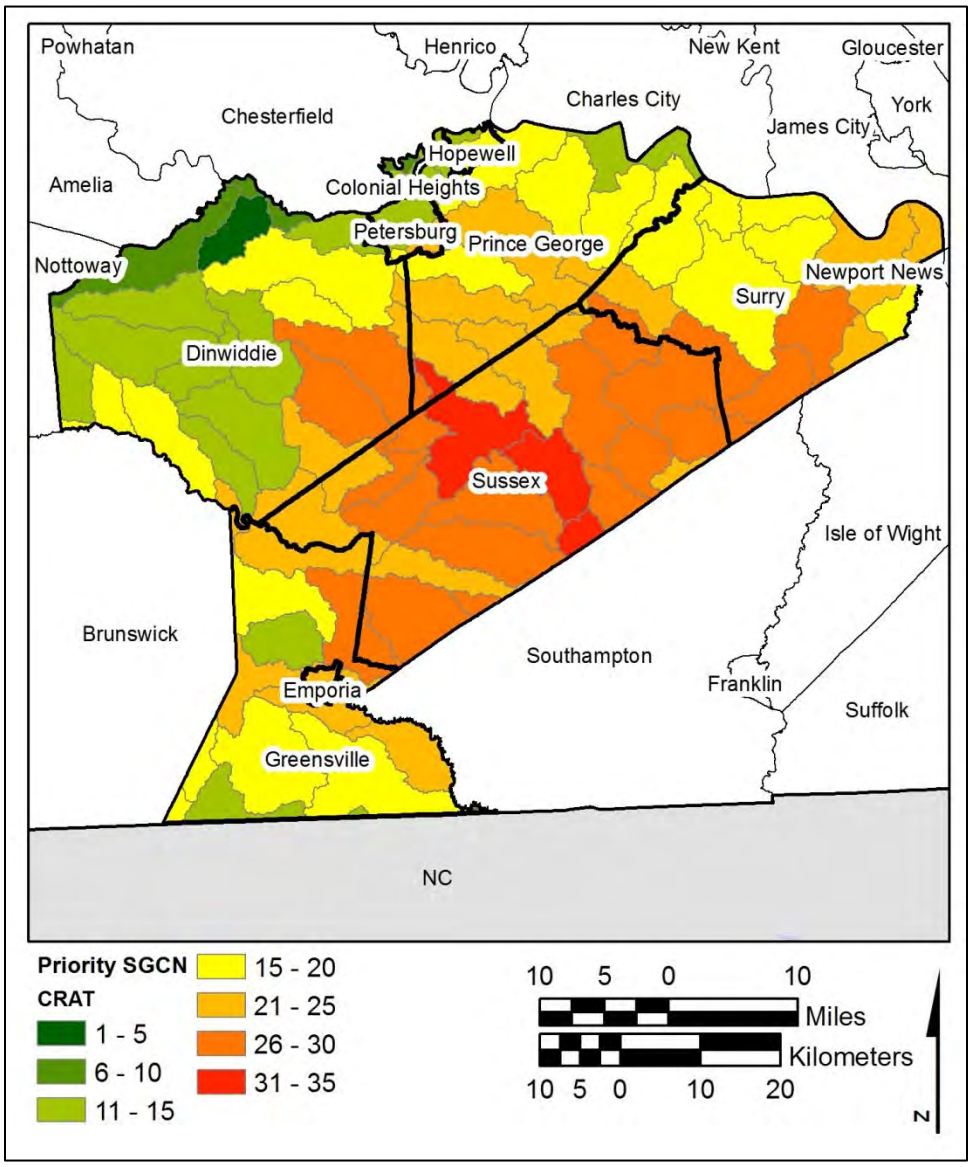

Figure 3. Priority SGCN Density in the Crater Planning Region (HUC12).

Table 2. Priority Species of Greatest Conservation Need Distribution within Crater Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		III	a	Dwarf waterdog	*Necturus punctatus*	Sluggish streams and blackwater streams with debris
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*	Forest and upland habitat generalist but require soils suitable for digging
Amphibian		IV	a	Greater siren	*Siren lacertina*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*	Most abundant in wetlands within pine savanna habitats
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*	Pine and hardwood forests with vernal ponds and other water sources suitable for breeding
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*	Gum and cypress swamps as well as other wooded wetlands
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*	Pine savanna
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*	Grassy wet areas within or near pine forests
Bird	**ST**	I	a	Bachman's sparrow	*Peucaea aestivalis*	Pine savanna/ open pine woodlands
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
BIrd		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*	Variety of marshes, swamps, and wooded streams
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.

Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	b	Clapper rail	*Rallus longirostris*	Saltmarshes
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association.
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests.
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird		III	b	Least bittern	*Ixobrychus exilis exilis*	Freshwater marshes
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		III	a	Northern bobwhite	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.

Bird	**FESE**	I	a	Red-cockaded woodpecker	*Picoides borealis*	Pine savanna
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*	Sluggish streams and swamps with abundance of dead wood on the bottom
Fish		IV	a	Alewife	*Alosa pseudoharengus*	Migratory
Fish		IV	c	American brook lamprey	*Lampetra appendix*	Requires clear flowing water but can tolerate a range of temperatures and substrates
Fish		IV	a	American shad	*Alosa sapidissima*	Large unfragmented migratory rivers for spawning
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory and utilize variety of aquatic and marine habitats
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*	Blackwater swamps, ponds, and streams with thick vegetation
Fish	**SE**	I	a	Blackbanded sunfish	*Enneacanthus chaetodon*	Acidic pools, creeks, and swamps with thick vegetation
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*	Moderately acidic creeks, streams, and swamps
Fish		IV	c	Lake chubsucker	*Erimyzon sucetta*	Clear to slightly stained warm water ponds, lakes, ditches, and streams
Fish		IV	c	Lined topminnow	*Fundulus lineolatus*	Moderately acidic margins of swamps and creeks with dense vegetation
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*	Swamps, ponds, and slow moving water
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*	Warm large creeks, streams, and small rivers with low gradient and typically clear water.
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*	Warm clear stream and rivers with low to moderate gradient and unsilted substrate

Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*	Clear to somewhat turbid creeks, with varying substrates
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*	Clean swift waters with stable gravel or sand/ gravel substrate
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*	Small streams to rivers with swift flow and sandy substrates
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*	Clean warm streams and rivers with low to moderate current and unsilted substrates
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*	Areas of limited currents and significant amounts of fine organic matter. Can tolerate a wide range of substrates
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*	Streams and rivers with high ground water content and good flow
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*	Shallow water near stable banks with intact riparian zones and soft substrates
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*	Clean water with slow currents and sandy substrates, most often found in rivers with stable shorelines and wide riparian forests
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*	Deeper channels of relatively fast flowing rivers
FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*	No specific habitats have been identified for this aquatic snail but it occurs across most of North America
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*	Large streams and rivers with low gradient and sand and gravel substrates
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*	Freshwater and brackish marsh
Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*	Riparian forests
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*	Freshwater wetlands
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*	Use hollow trees as well as various types of human structures for roosting
Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*	Open mature stands of pine or pine/hardwoods
Mammal		IV	b	Southeastern myotis	*Myotis austroriparius*	Riparian forests with suitable roost structures
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	Upland pine habitats

Reptile		IV	a	Mudsnake	*Farancia abacura abacura*	Wetland generalist as long as aquatic salamanders are present
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*	Riparian forest - eel obligate
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*	Forest generalist but require soils suitable for digging
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*	Freshwater swamps and marshes
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed(FP), and Species of Collection Concern (CC).

Conserved Lands in the Crater Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. The conservation mechanisms range from conservation easements to state parks to state wildlife management areas, and National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- James River National Wildlife Refuge,
- Hog Island Wildlife Management Area
- Big Woods Wildlife Management Area,
- Piney Grove Preserve,
- Petersburg National Battlefield Park, and
- Chippokes Plantation State Park.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities. In addition to supporting mission functions, lands on the Fort Pickett Military Reservation and the Fort Lee Military Reservation also support a diversity of wildlife and habitats.

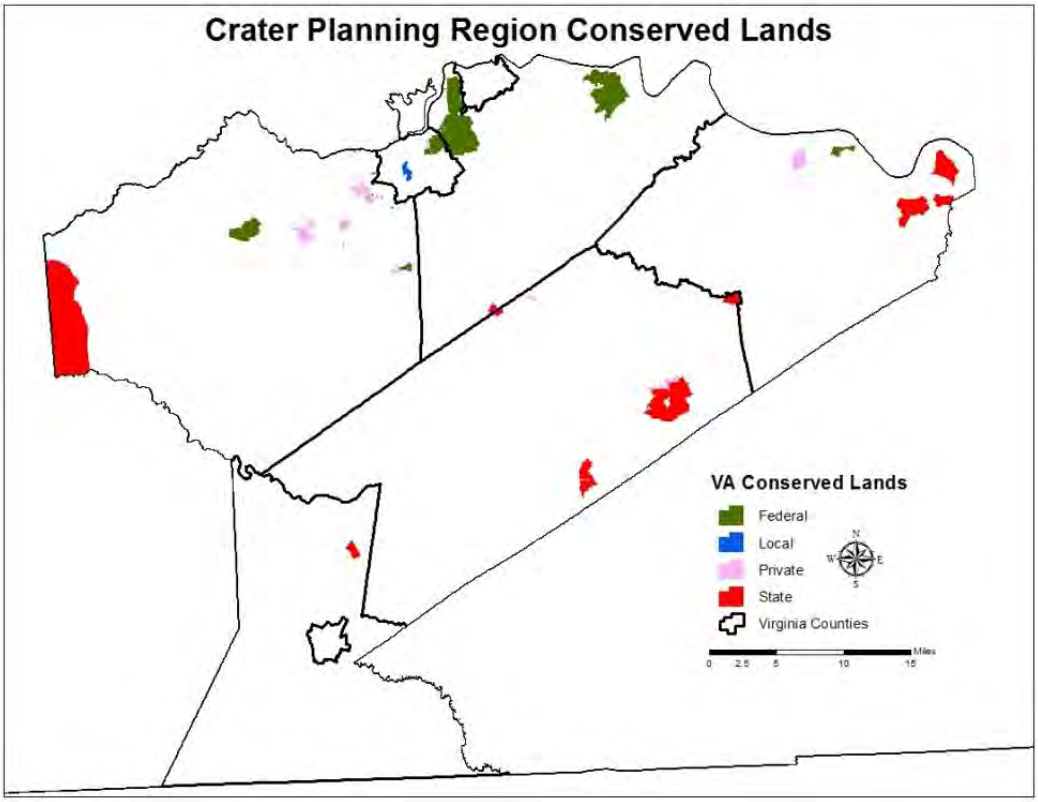

Figure 4. Conservation Lands in the Crater Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Crater Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting additional lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Crater Planning Region

Although Crater Planning Region is further inland than other coastal planning regions, climate change and resulting sea-level rise and storm-related events may affect areas within the region. A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events also are projected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are likely to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase storm water overflows and sewage contamination (VIMS 2013). VIMS also estimates that given these projections, approximately 30 miles of coastline within this planning region will be vulnerable to sea-level rise (shoreline in Charles City, Chesterfield, Prince George, and Surry) (VIMS 2013; Titus 2010).

Changes in temperature and precipitation will also negatively affect habitats and SCGN in the Crater Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in Crater Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Crater Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 3. Summary of Conservation Strategies and Actions for Crater Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, climate change, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, maintain and restore aquatic and shoreline habitats	1) Work with landowners to implement small acreage grazing systems; 2) Repair/ replace failing septic systems; 3) Establish riparian vegetative buffers along waterways; 4) Establish waste storage facilities to better manage animal waste and prevent flow into rivers; 5) Establish retention ponds or features to manage and slow urban storm water runoff; 6) Work to prevent pet waste from entering waterways; 7) Continue to identify impaired waters within the planning region; 8) Restore aquatic connections; 9) Monitor and address invasive species impacts; and 10) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Beaver Pond Creek, Cypress Swamp, Little Nottoway River, Mill Swamp, Raccoon Creek, Rattlesnake Swamp, Three Creek, Upper Nottoway River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; and ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers	Pine savannas not already protected

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Crater Planning Region. In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes are the most common wetland type in this area (Table 4). These wetlands provide valuable habitats for the marsh rabbit, black crowned night herons, yellow rails, and a variety of other species.

Table 4. Wetland Acreage in Crater Planning Region (Anderson et al. 2013).

Wetland Type	Total Acres	Percent of Planning Region
Non-Tidal Wetlands	170,189.50	13.70%
Tidal Wetlands	7,418.56	0.60%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to tidal and non-tidal wetlands is conversion to other uses and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of tidal wetland habitat through damage or loss to wetland vegetation. Mute swans out-compete native species by consuming significant amounts of emergent and submerged aquatic vegetation (DGIF 2012). Mute swans can also destroy vegetation by uprooting it, thereby limiting the effectiveness of wetland restoration (DGIF 2012). Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites*, purple loosestrife, Japanese stilt grass, and exotic invertebrates.

4. Climate Change: As sea levels rise, marshes can be inundated and convert to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open water habitats and salt marshes likely will not support the same vegetative composition as the non-tidal and tidal wetlands in this planning region, affecting the wildlife species that depended on these

habitats (CCSP 2009). Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Crater Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option to for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods, living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate inland as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands also is important to protect health of the existing wetlands as well as to provide a potential inland migration route as conditions change (Kane 2011). The protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Crater Planning Region include those wetlands that are inland of tidal wetlands that may provide some opportunity for inland migration as sea levels rise. These more inland areas also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as

conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). The wetlands catalog indicates healthy wetlands occur throughout the planning region. Wetlands adjacent to conserved lands have a higher priority. Likewise, wetland restoration opportunities also occur throughout the region. Restoration efforts should focus on wetlands adjacent to either conserved lands or adjacent or upstream from healthy wetlands. Restoration priority areas are extensive in Surry and Dinwiddie counties and in some cases are adjacent to already protected lands.

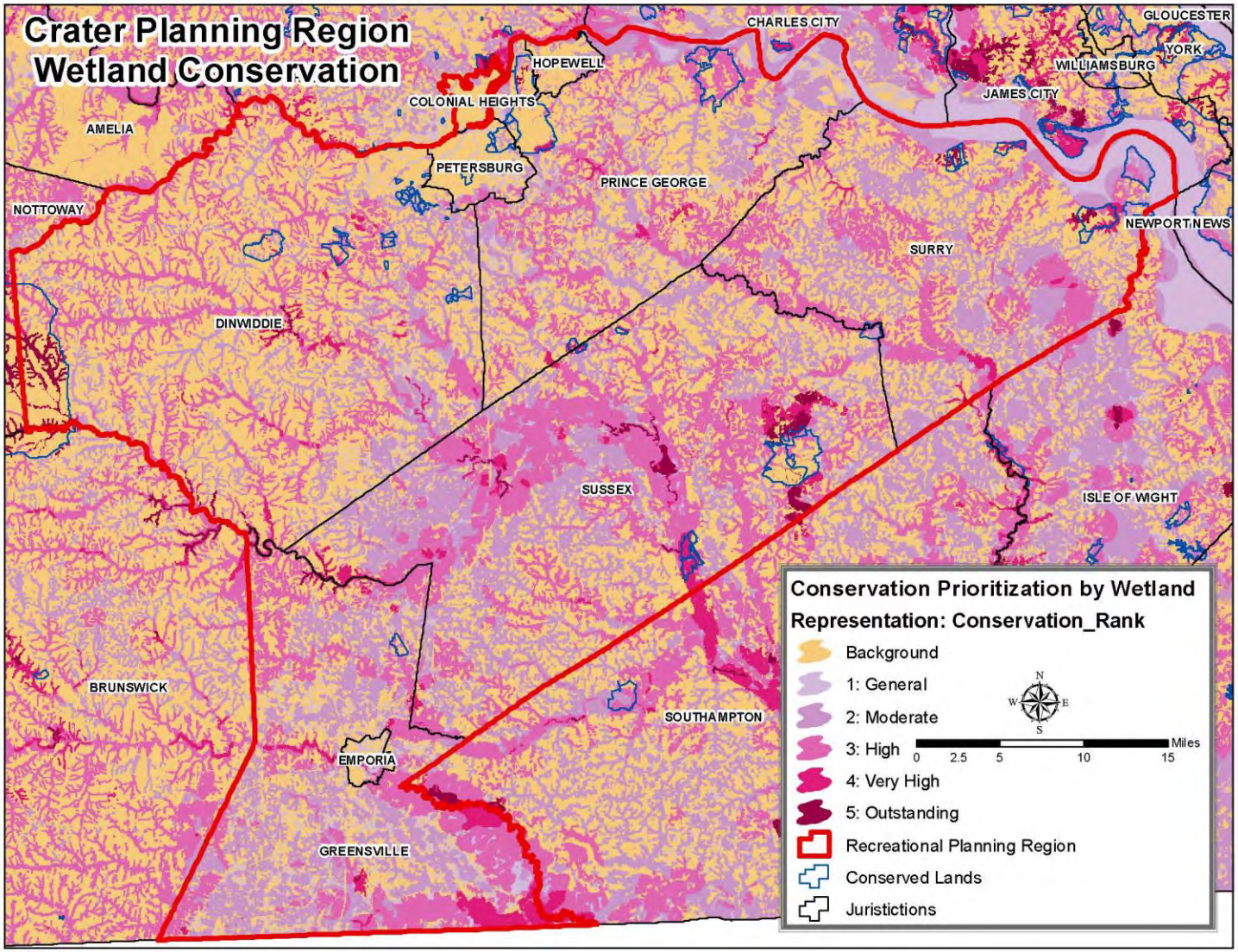

Figure 5. Wetland Conservation Priority Areas in Crater Planning Region (Weber and Bulluck 2014).

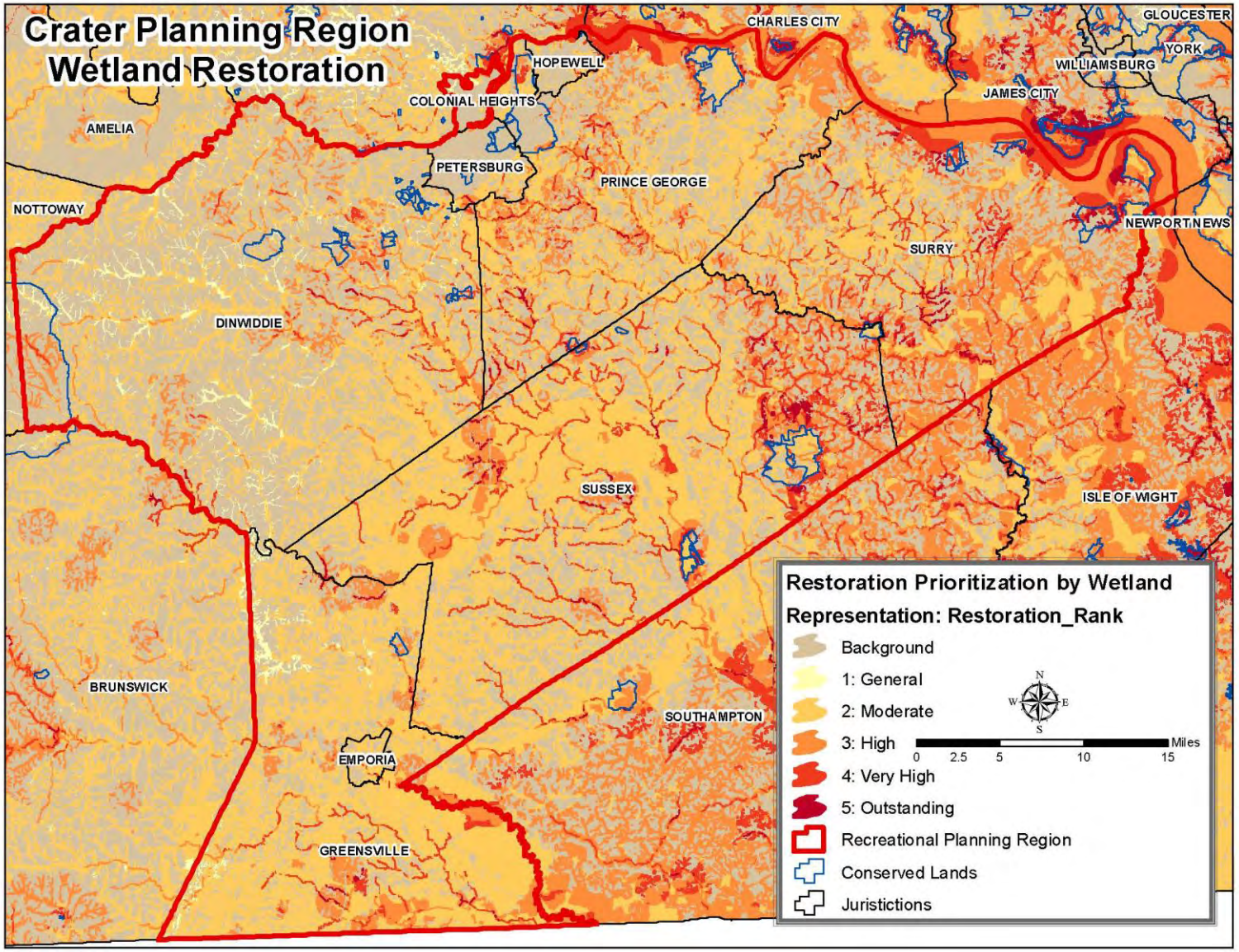

Figure 6. Wetland Restoration Priority Areas in Crater Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Crater Planning Region include tidal and non-tidal freshwater creeks and streams. These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. The Crater Planning Region also contains some of the best examples of Virginia's remaining blackwater habitats. Blackwater streams occur south of the James River, and they consist of sandy soils with tannin stained waters and little suspended clay sediment. They often are associated with bald cypress and tupelo as well as other bottomland hardwoods, but they also may have small, shrubby sloughs and shrub and herb layers (Anderson et al. 2013). Approximately 40,850 acres (3.3 percent) of the planning region is considered aquatic (Anderson et al. 2013). Priority SGCN that depend on these aquatic systems within this planning region include the blackbanded sunfish, Chowanoke crayfish, toplined minnow, dwarf wedge mussel, and ridged lioplax snail.

Threats

Aquatic and riparian habitats within the Crater Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Crater Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in

hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Much of the Crater Planning Region has a low percentage of impervious surface cover, however; the larger population center has a higher percentage of impervious surfaces (Figure 7).

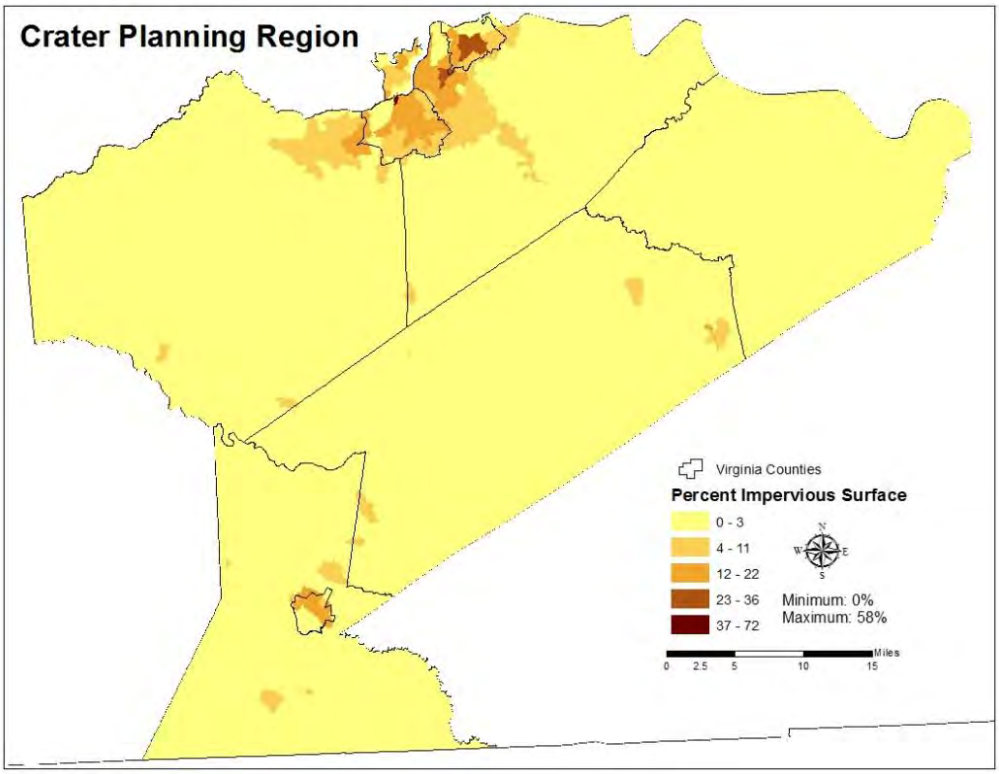

Figure 7. Impervious Surface Cover in Crater Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Crater Planning Region include invasive species, such as blue catfish, mute swans, Asian carp (e.g., big head carp and grass carp) that either consume native species or consume aquatic vegetation that alter the quality of these aquatic habitats and invasive species that impair waterways.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the

aquifer that could degrade the quality of both subterranean and surface water.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by partners for the Virginia Department of Environmental Quality (DEQ). Watersheds within the planning region that have Water Quality Improvement Plans include: Beaverpond Creek (MapTech and New River-Highlands 2005), Cypress Swamp (MapTech and New River-Highlands 2005), Little Nottoway River (MapTech and New River-Highlands 2005), Mill Swamp (Working Group 2013), Raccoon Creek (MapTech and New River-Highlands 2005), Rattlesnake Swamp (MapTech and New River-Highlands 2005), Three Creek (Working Group 2013), and Upper Nottoway River (MapTech and New River-Highlands 2005) (Figure 8).

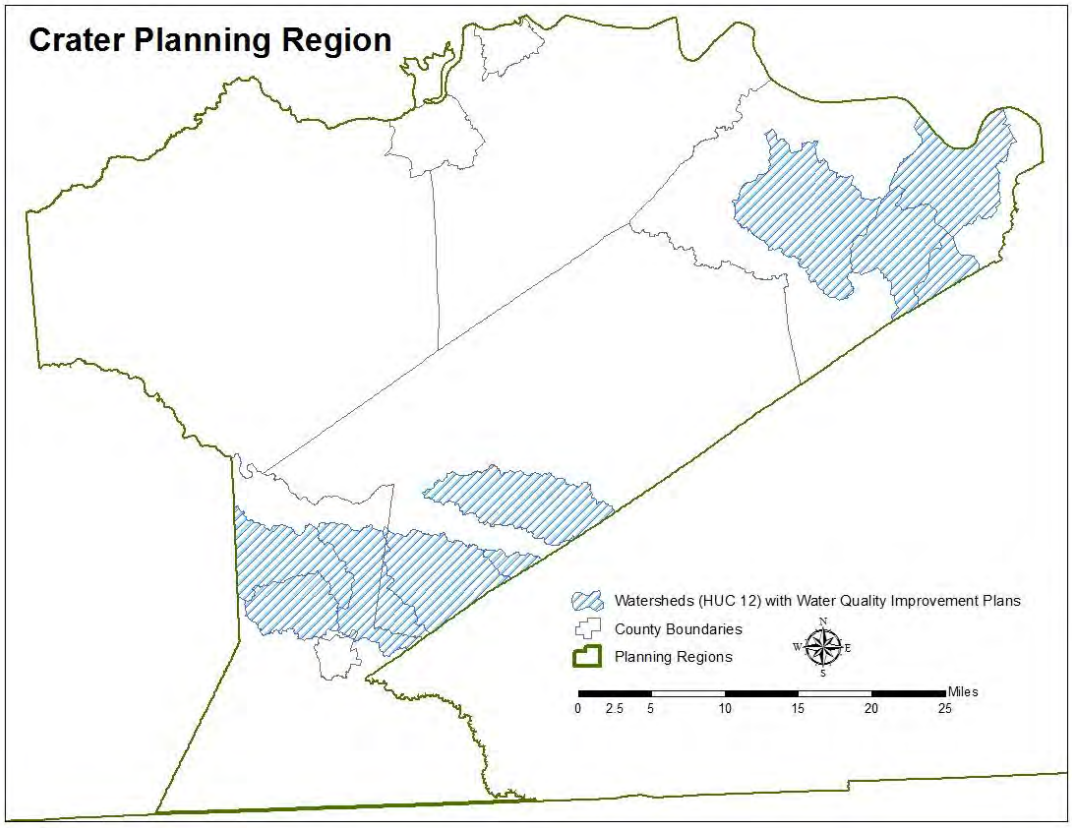

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality in these watersheds include:

- Establishing riparian vegetative buffers along waterways;

- Reforesting erodible pasture lands and establishing permanent vegetative cover on critical areas;
- Establishing waste storage facilities (such as dairy lagoons or waste sheds) to better manage animal waste and prevent flow into the river;
- Establishing retention ponds, impoundments, or other features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands;
- Working with landowners to implement small acreage grazing systems;
- Repairing or replacing failing septic systems and pit privies; and
- Working to prevent pet and kennel waste from entering waterways and establishing a pet litter program to encourage owners to clean up pet waste.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

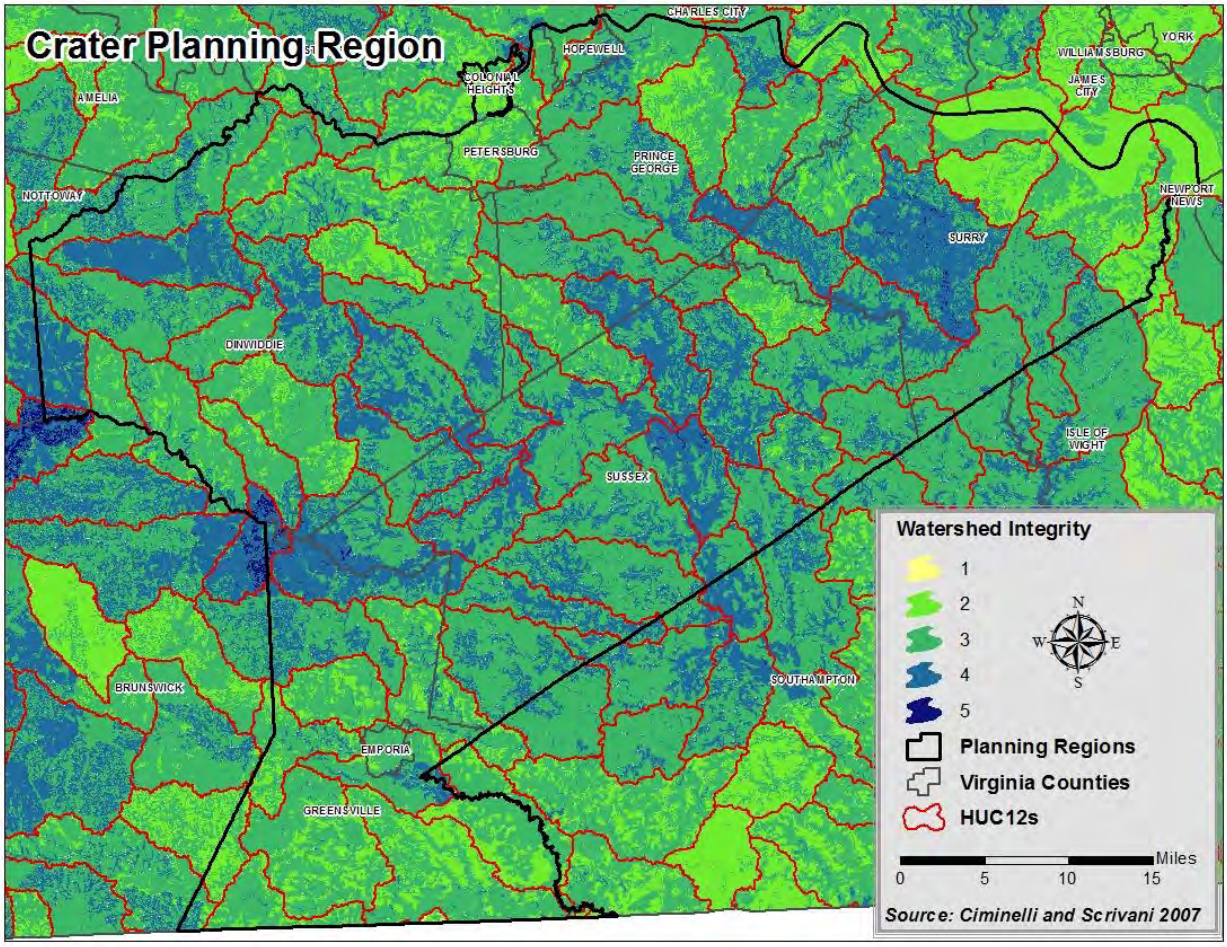

Figure 9. Watershed Integrity Model for Crater Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Crater Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 9) (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Crater Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts as well as promoting efforts to rinse boats and trailers on site, and working with the planning region to adopt land use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

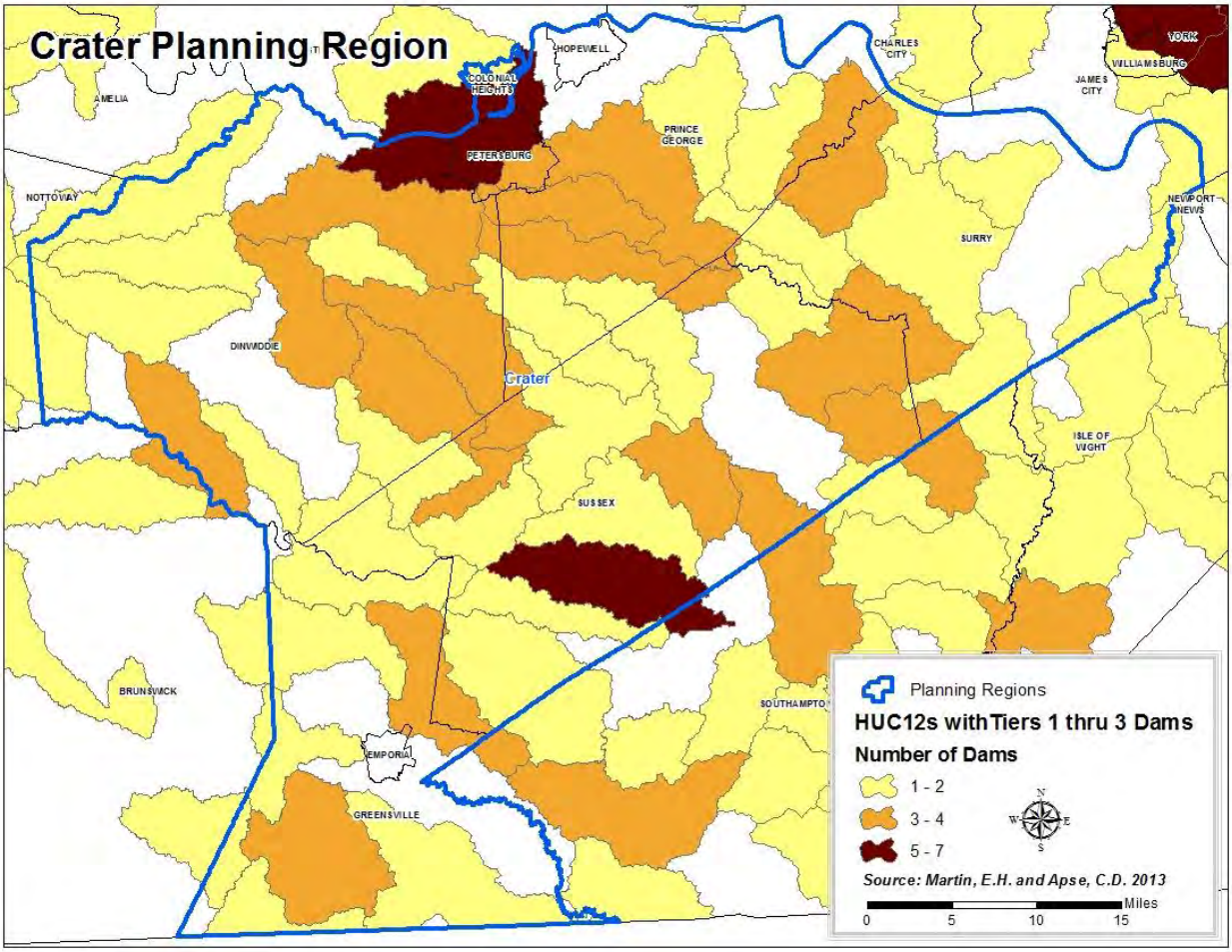

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change.

Because sea-level rise will likely be an issue, tree and shrub species that have a broader salinity tolerance should be considered. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving

stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up over a fourth of Crater Planning Region and are important for a broad range of species (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the northern scarletsnake, Rafinesque's big-eared bat, eastern spadefoot toad and southeastern fox squirrel.

Table 5. Forest Acreage Totals in Crater Planning Region (Anderson et al. 2013).

Forest Type	Acres	Percent of Planning Region
Mixed Hardwood and Conifer	327,078.87	26.33%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Crater Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species such as privet and Japanese stilt grass and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Crater Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Water Quality Improvement Plan to Reduce Bacteria in Darden Mill Run, Mill Swamp, and Three Creek* developed for DEQ specifically highlights reforesting areas around eroding crop lands and pastures within the Three Creek watershed to help decrease sediment run off as well as provide wildlife habitat (Working Group 2013).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to, using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent their spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Crater Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult recently available climate data through DGIF as well as the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers may want to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are generally comprised of post-agricultural lands, pine savannas, and barrens and glades and make up approximately 129,900 acres (10.5 percent) of this planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. This planning region contains some of the best examples of longleaf pine savanna in Virginia. Long leaf pine savanna habitat is a regionally significant resource necessary to the conserve the red cockaded woodpecker, Bachman's sparrow, southern chorus frog, and other species.

Threats

Changing land use patterns has played a large role in the loss of open forests habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve development (where habitats are converted for human use) and natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

3. Pine Savannas: Threats to pine savannas include lack of opportunities for restoration due to limited acreage and proximity to population centers, which limits controlled burns that are needed to maintain these forests.

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas has caused significant declines in several Action Plan species, including the red cockaded woodpecker, the northern bobwhite, field sparrows, eastern towhees, brown thrashers, prairie warblers, and monarch butterflies. The loss of these habitats has likely contributed to the declines in native pollinator species such as bumblebees (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading

the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Sussex County and Greenville County offer some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are significant industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail. Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management (Puckett et al. 2008).

This planning region also contains some of the best examples of remaining long-leaf pine savanna in Virginia, which provide habitat for the southeastern fox squirrel. Almost all of these sites are owned and managed by government agencies or The Nature Conservancy. Although once a critical economic commodity for Virginia's maritime industries, the economic value of long-leaf pine has been overshadowed by the faster growing, and more commercially viable, loblolly pine. As such, few individual landowners have the economic ability to restore large areas of long-leaf pine on their properties to maintain savanna conditions. Opportunities to create new savanna habitats within this planning region will depend upon the conservation community acquiring properties with suitable soil conditions and managing these properties for savanna conditions. Properties near or adjacent to existing savannas should be considered a conservation priority.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats, if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open habitats within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant opportunities to do valuable things for wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Crater Planning Region, priority conservation opportunities include:

- Protecting and restoring tidal and non-tidal wetlands;
- Improving the quality and quantity of water in creeks and rivers through best management practices and water quality improvement mechanisms;
- Conserving tracts of mature hardwood forests; and
- Protecting and restoring open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN CRATER PLANNING REGION

Complete SGCN list for the Crater Planning Region (SGCN=106). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa. .

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian	**ST**	II	a	Barking treefrog	*Hyla gratiosa*
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*
Amphibian		III	a	Dwarf waterdog	*Necturus punctatus*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird	**ST**	I	a	Bachman's sparrow	*Aimophila aestivalis*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird	**SE**	I	a	Black rail	*Laterallus jamaicensis*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	b	Clapper rail	*Rallus longirostris*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*

Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		II	b	King rail	*Rallus elegans*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Least tern	*Sterna antillarum*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird	**FESE**	I	a	Red-cockaded woodpecker	*Picoides borealis*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*
Fish	**SE**	I	a	Blackbanded sunfish	*Enneacanthus chaetodon*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*
Fish		IV	c	Lake chubsucker	*Erimyzon sucetta*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Lined topminnow	*Fundulus lineolatus*

Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*
FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*
Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*
Mammal		IV	b	Southeastern myotis	*Myotis austroriparius*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*

Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

9. Cumberland Plateau Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

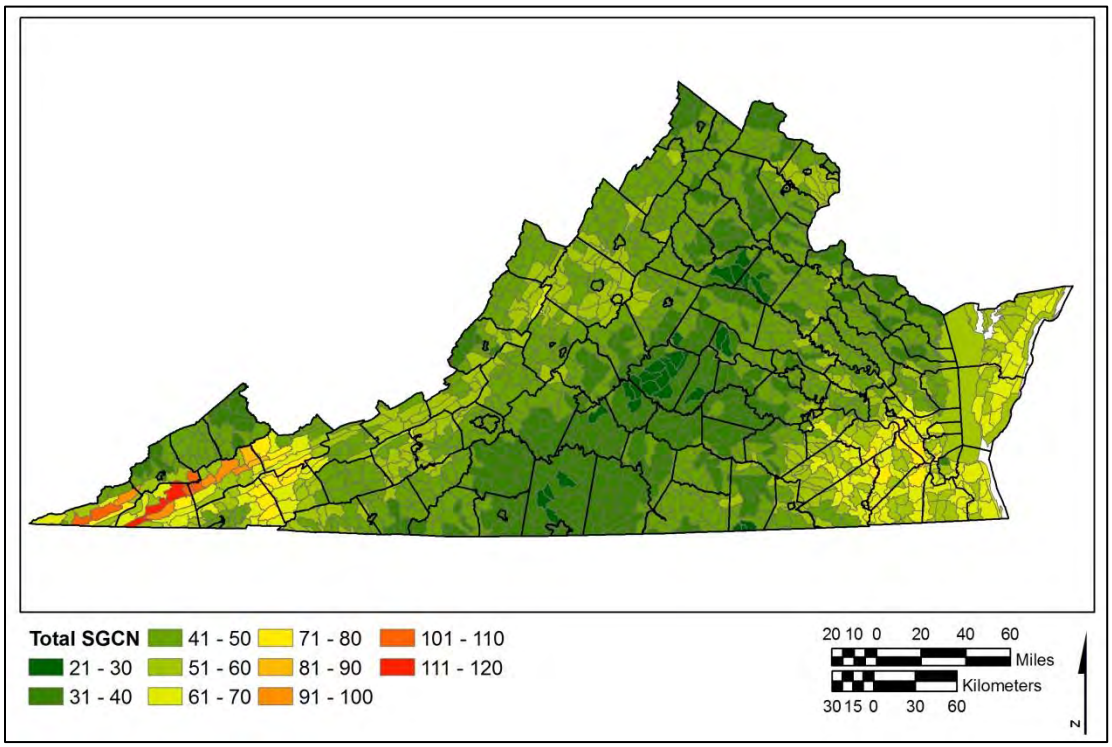

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

CUMBERLAND PLATEAU PLANNING REGION SUMMARY OVERVIEW

The Cumberland Plateau Planning Region consists of 1,173,394 acres (1,833 square miles) and includes the counties of Buchanan, Dickenson, Russell, and Tazewell and towns of Richlands, Tazewell, and Bluefield. The human population in this planning region is estimated to be almost 110,000 people. Populations in these counties have been decreasing and are projected to continue to decrease by 2020 (U.S. Census Bureau 2015; DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or energy and other extractive uses expand. This planning region contains a range of SGCN, including 9 SGCN that have 100 percent of their distribution within this planning region. They are Hubricht's cave beetle, Clinch dace, Beartown perlodid stonefly, brown supercoil, cave lumbriculid worm, Big Cedar Creek millipede, suckermouth minnow, Bluestone sculpin, and an unnamed millipede. The planning region also includes a variety of habitats such as mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

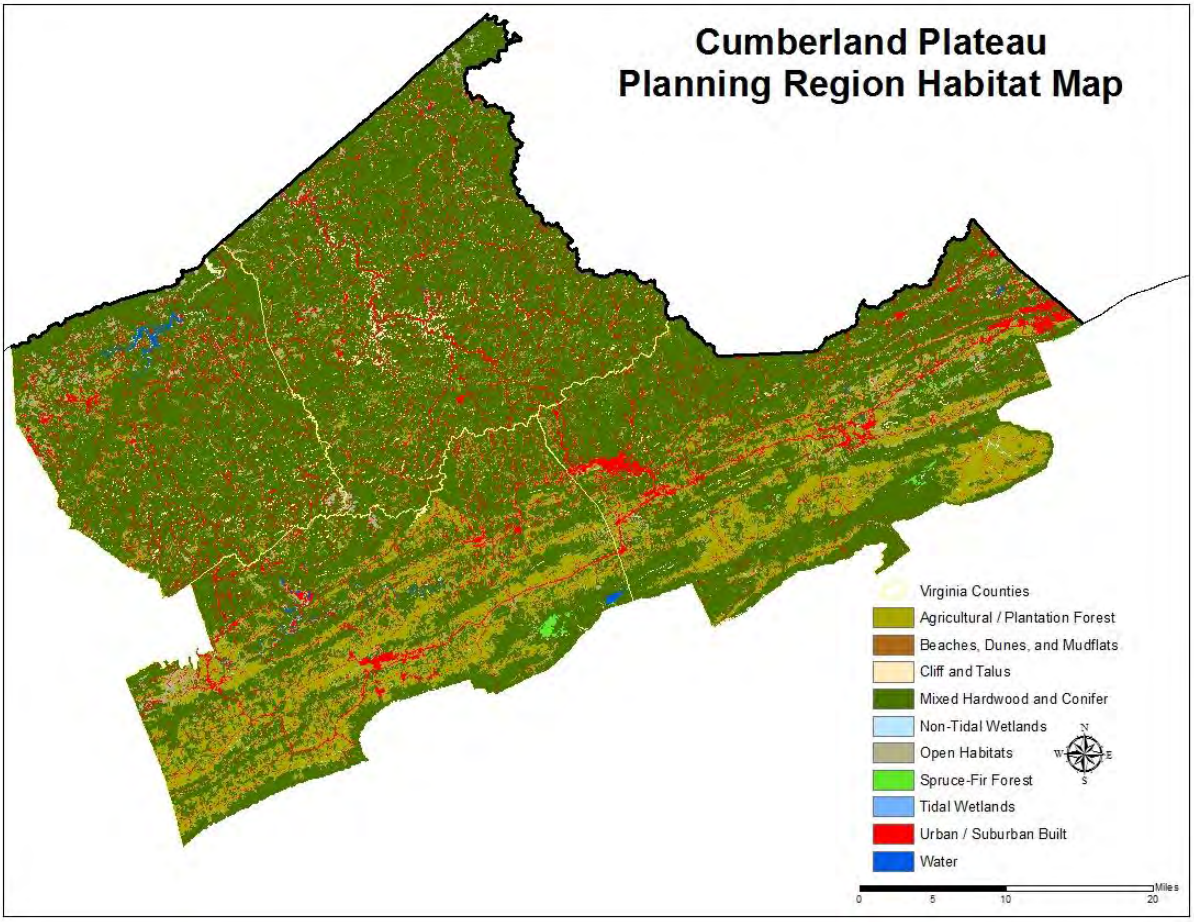

Figure 2. Cumberland Plateau Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 165 are believed to either occur, or have recently occurred, within the Cumberland Plateau Planning Region (Appendix A). Of these 166 species, ***151 SGCN, are dependent upon habitats provided within the Cumberland Plateau Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 150 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	23
Ib	8
Ic	7
IIa	9
IIb	3
IIc	20
IIIa	10
IIIb	5
IIIc	15
IVa	17
IVb	9
IVc	25

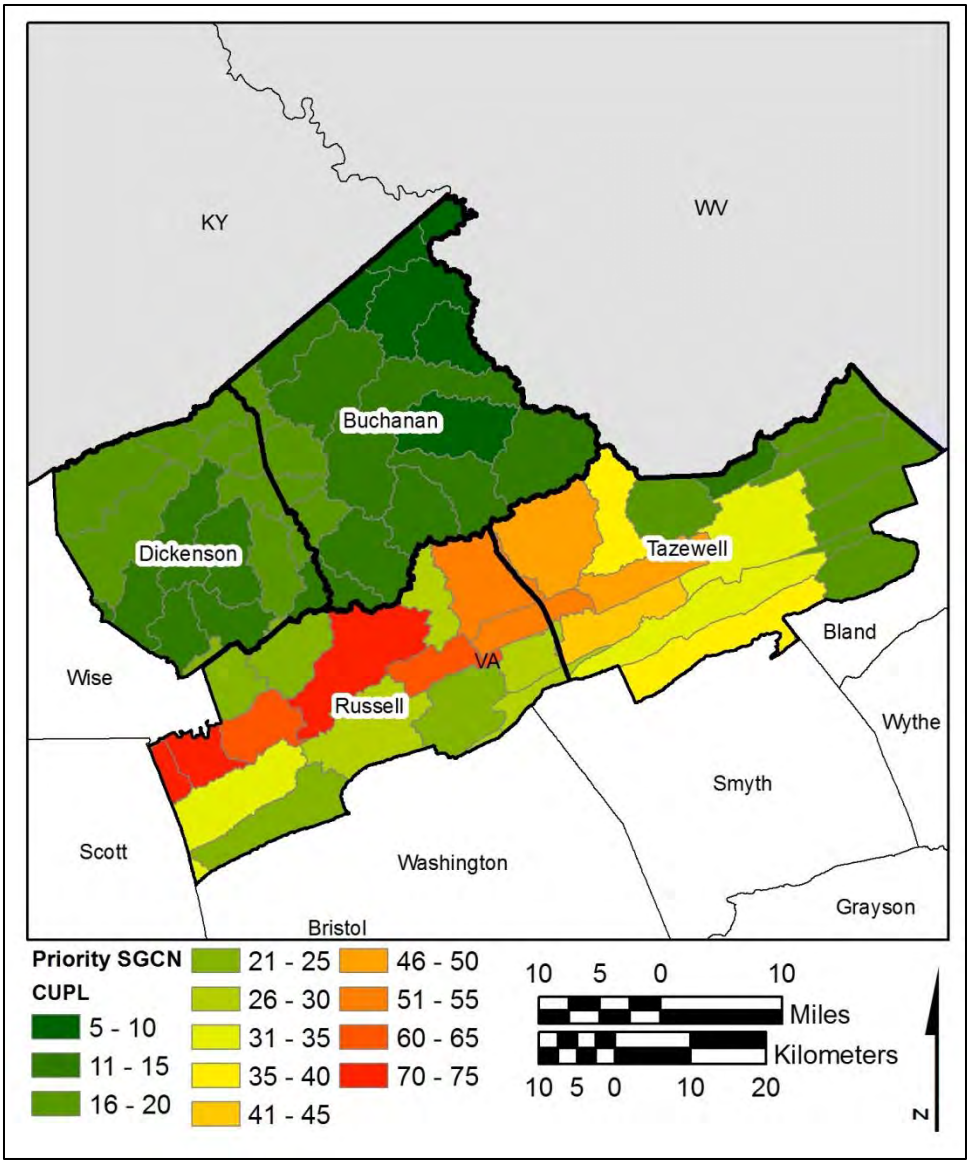

Figure 3. Priority SGCN Density in the Cumberland Plateau Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within the Cumberland Plateau Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*	High elevation seeps, streams, wet rock faces, and riparian forests
Amphibian		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*	Mature hardwood forests in the vicinity of rocky outcrops
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Clean streams and rivers with rocky substrates
Amphibian		II	b	Green salamander	*Aneides aeneus*	Damp, but not wet, crevices in shaded rock outcrops and ledges in forested areas
Amphibian		II	c	Mountain chorus frog	*Pseudacris brachyphona*	Forested areas up to 3500 feet that contain suitable breeding sites
Amphibian		II	c	Southern zigzag salamander	*Plethodon ventralis*	Hardwood forests in the vicinity of rocky outcrops
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		IIi	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets.
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth.
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.

Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association.
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests.
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*	Open shrubby habitat (ex. old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Bird		III	c	Red crossbill	*Loxia curvirostra*	Spruce-fir or hemlock forests above 4000 feet
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland (AOU 1983).
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*	Forested moist lower slopes with a rhododendron shrub layer
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.

Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FSSE**	I	c	Big Sandy Crayfish	*Cambarus veteranus*	Warm streams with fast flows and bedrock, cobble, boulder, and sand substrates
Crustacean		III	c	Reticulate crayfish	*Oroconectes erichsonianus*	Streams with rocky substrates
Fish	**FS**	I	b	Ashy darter	*Etheostoma cinereum*	Clear cool or warm streams with moderate gradient with rubble and boulder substrates
Fish		IV	c	Black sculpin	*Cottus baileyi*	Cold creeks and streams with moderate to high gradient and clean gravel and boulder substrates
Fish		IV	c	Blotched chub	*Erimystax insignis*	Clean, cool to warm, streams and rivers with moderate gradient and clean gravel and rubble substrates
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*	Clear warm streams and rivers with moderate gradient with silt free gravel, rubble, or boulder substrates
Fish	**FS**	III	c	Bluestone sculpin	*Cottus sp. 1*	Cool or cold limestone spring runs with strong flows and gravel or rubble substrates and aquatic vegetation
Fish		IV	c	Brook silverside	*Labidesthes sicculus*	Clear cool or warm lakes and large rivers and can tolerate various substrates and various amounts of aquatic vegetation
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*	Clear creeks and streams with rocky substrates
Fish		III	c	Channel darter	*Percina copelandi*	Warm rivers with moderate to swift flows and gravel and rubble substrate
Fish	**FS**	I	a	Clinch dace	*Chrosomus sp. cf. saylori*	Small high elevation streams with gravel substrates and forested watersheds
Fish	**FS**	III	c	Clinch sculpin	*Cottus sp. 4*	Cold clear spring runs to rivers with moderate to high gradients and unsilted gravel, rubble, and boulder substrates
Fish		III	c	Common mudpuppy	*Necturus maculosus maculosus*	Permanent lakes, ponds, impoundments, streams, and rivers with suitable hiding cover
Fish		IV	c	Dusky darter	*Percina sciera*	Warm streams and rivers with low gradients and unsilted gravel substrates
Fish	**FESE**	I	a	Duskytail darter	*Etheostoma percnurum*	Clear, warm, moderate gradient intermontane streams and rivers with clean gravel, rubble, or boulder substrates

Fish	**ST**	IV	c	Emerald shiner	*Notropis atherinoides*	Clear large streams and rivers with low gradient.
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*	Warm turbid water in lakes, reservoirs, and pools in low gradient rivers over mud substrate
Fish	**FS**	III	c	Holston sculpin	*Cottus sp. 5*	Clear streams with moderate to high gradient and clean gravel, rubble, or boulder substrates
Fish		IV	c	Logperch	*Percina caprodes*	Warm, moderate gradient, streams and rivers with gravel and rubble substrates
Fish		III	c	Mirror shiner	*Notropis spectrunculus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*	Cool creeks or streams with moderate flow and clean substrates with access to pool sediments and muddy banks for ammocoetes
Fish		IV	c	Mountain madtom	*Noturus eleutherus*	Clear, warm streams and rivers with gravel and rubble substrates and vegetated riffles
Fish		IV	c	Mountain shiner	*Lythrurus lirus*	Typically in clear, flowing, riffle-pool type creeks and small rivers with moderate gradients and bottom materials ranging from sand- gravel to rubble-boulder
Fish		IV	c	Northern studfish	*Fundulus catenatus*	Cutoff pools, backwaters, and sluggish margins of clear, warm, moderate gradient creeks, streams and rivers with a variety of substrates
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*	Large warm rivers with clean gravel and rubble substrates and access to low gradient areas with soft substrates and detrital material for ammocoetes
Fish	**ST**	IV	c	Paddlefish	*Polyodon spathula*	Warm medium to large rivers with very low flows
Fish		II	c	Popeye shiner	*Notropis ariommus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		III	b	River redhorse	*Moxostoma carinatum*	Clean streams and rivers with unsilted gravel, rubble, and boulder substrates
Fish		IV	c	Sand shiner	*Notropis stramineus*	Warm streams with low to moderate gradient and clean sand and gravel substrates
Fish		III	b	Sauger	*Sander canadensis*	Cool large streams, rivers, and lakes with a combination of deep swift runs and backwaters
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*	Moderate gradient streams and rivers with unsilted gravel, rubble, and boulder substrates
Fish	**FTST**	I	c	Slender chub	*Erimystax cahni*	Clear, open, and swift streams and rivers with unsilted gravel substrates
Fish		IV	c	Speckled darter	*Etheostoma stigmaeum*	Aquatic
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*	Clean medium sized streams and rivers with clean gravel and cobble substrate

Fish	**ST**	III	c	Steelcolor shiner	*Cyprinella whipplei*	Warm low to moderate gradient streams and rivers over a variety of substrates
Fish		IV	c	Stonecat	*Noturus flavus*	Warm streams and rivers with moderate to low gradient with rocky substrates
Fish		IV	c	Suckermouth minnow	*Phenacobius mirabilis*	Warm, clear to turbid streams and rivers with moderate gradient with sand and gravel substrate
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*	Cool clear streams with moderate to high gradient with clean gravel, rubble, and boulder substrates
Fish		IV	c	Tangerine darter	*Percina aurantiaca*	Clean, cool and warm streams and rivers with moderate gradient and a variety of substrates
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*	Clean creeks with rock, gravel, or silt substrates and stable banks
Fish	**SE**	I	a	Variegate darter	*Etheostoma variatum*	Warm to cool water streams with clean gravel, rubble, or boulder substrates
Fish		III	c	Wounded darter	*Etheostoma vulneratum*	Warm moderate gradient streams and rivers with clean gravel and rubble substrate
Fish	**FTST**	I	a	Yellowfin madtom	*Noturus flavipinnis*	Warm, clear streams and rivers with moderate gradient and variety of cover types
FW Mollusk	**FESE**	I	a	Appalachian monkeyface	*Quadrula sparsa*	River headwaters with fast flow and various substrates
FW Mollusk	**FESE**	I	a	Birdwing pearlymussel	*Lemiox rimosus*	Aquatic
FW Mollusk	**ST**	III	a	Black sandshell	*Ligumia recta*	Medium to large rivers with strong currents and sand, gravel, and cobble substrates
FW Mollusk		III	c	Brown walker	*Pomatiopsis cincinnatiensis*	Amphibious - vegetated banks of streams, creeks, and rivers
FW Mollusk	**FESE**	I	b	Cracking pearlymussel	*Hemistena lata*	Medium sized rivers with moderate current and mud, sand, and fine gravel substrates
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk	**FESE**	I	a	Cumberland bean	*Villosa trabalis*	Clear, warm streams and small rivers with moderate to swift currents and unsilted sand, gravel, and rubble substrates
FW Mollusk		IV	a	Cumberland moccasinshell	*Medionidus conradicus*	Small headwater streams with sand and gravel substrates and extends well into medium sized rivers
FW Mollusk	**FESE**	I	a	Cumberland monkeyface	*Quadrula intermedia*	Small to medium sized streams with fast current and silt-free sand, gravel, and rubble substrates
FW Mollusk	**FESE**	I	a	Cumberlandian combshell	*Epioblasma brevidens*	Large creeks to large rivers with gravel, cobble, and boulder substrates

FW Mollusk	**SE**	III	b	Deertoe	*Truncilla truncata*	This species is a generalized in terms of substrate preference, usually occurring in fine gravel mixed with sand and mud. It is also considered a generalist in terms of the size of rivers it inhabits. It is more common in medium-sized rivers but may become numerous in large rivers, where it can live at depths of 12 to 18 feet. It will also establish viable populations in lakes lacking current
FW Mollusk	**FESE**	I	a	Dromedary pearlymussel	*Dromus dromas*	Clean fast moving water with firm, unsilted, sand and gravel substrates
FW Mollusk	**SE**	III	a	Elephant ear	*Elliptio crassidens*	Large creeks to rivers with moderate to swift currents and mud, sand, or rocky substrates
FW Mollusk		II	c	Elktoe	*Alasmidonta marginata*	Small shallow rivers with moderately fast current and sand and gravel substrates
FW Mollusk	**FESE**	I	a	Fanshell	*Cyprogenia stegaria*	Mixed substrates of gravel, sand and cobble
FW Mollusk	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*	Clear high gradient streams in unsilted gravel and cobble substrates
FW Mollusk	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*	Small to medium rivers with swift current and sand, gravel, or cobble substrates
FW Mollusk	**ST**	IV	b	Fragile papershell	*Leptodea fragilis*	This species is tolerant of a variety of aquatic habitats and can be found in small streams in strong current with coarse gravel and sand substrates but also rivers or river-lakes possessing slow current and a firm substrate composed of sand and mud. It can occur at depths of up to 15 or 20 feet but reaches greatest population density at normal water levels of three feet or less in areas such as shallow embayments
FW Mollusk		I	a	Golden riffleshell	*Epioblasma florentina aureola*	Aquatic
FW Mollusk	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*	High gradient headwater streams
FW Mollusk		III	a	Longsolid	*Fusconaia subrotunda*	Medium to large rivers with strong currents and sand and gravel substrates
FW Mollusk		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*	Very clean small headwaters creeks and streams with sand and gravel substrates and associated with *Justicia* beds
FW Mollusk	**FESE**	I	a	Oyster mussel	*Epioblasma capsaeformis*	Warm creeks and rivers with moderate to swift current and sand, gravel, and boulder substrates

FW Mollusk	**ST**	IV	b	Pimple back	*Quadrula pustulosa pustulosa*	This species has generalized habitat preferences and can maintain abundant and viable populations in shallow to deep sections of large reservoirs as well as in small to medium-sized free-flowing rivers. It is usually found in a substrate consisting of coarse gravel, sand, and silt.
FW Mollusk		III	b	Pink heelsplitter	*Potamilus alatus*	On a variety of substrates in slow to swiftly flowing wate
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk	**FESE**	I	a	Purple bean	*Villosa perpurpurea*	Headwaters, creeks, and rivers and can tolerate a variety of currents and substrates
FW Mollusk	**FSSE**	II	c	Purple liliput	*Toxolasma lividus*	Small to medium sized streams in well packed sand or gravel substrates
FW Mollusk	**FSSE**	II	a	Pyramid pigtoe	*Pleurobema rubrum*	Medium and large rivers with flow and stable mud or mud/sand substrates
FW Mollusk	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*	Warm medium to large rivers with swift currents and silt, sand, gravel, or cobble substrates
FW Mollusk	**FPST**	II	a	Sheepnose	*Plethobasus cyphyus*	Warm large rivers and reservoirs with gravel and cobble substrates
FW Mollusk	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*	Moderate to swift current with stable sand, gravel, or cobble substrates
FW Mollusk	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*	Large creeks to moderate rivers with moderate flow and gravel and sand substrates
FW Mollusk	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*	Headwater creeks and small streams with constant flow and mud, sand, or gravel substrates and aquatic vegetation
FW Mollusk	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*	Small to medium sized creeks with swift current and sand, gravel, and cobble substrates
FW Mollusk	**FPSE**	I	b	Spectaclecase	*Cumberlandia monodonta*	Under slab rocks or in crevices beneath bedrock shelves
FW Mollusk	**FSST**	III	a	Spiny riversnail	*Io fluvialis*	Large rocks and bedrock outcrops in well-oxygenated shallow water with fast current
FW Mollusk		III	a	Tennessee clubshell	*Pleurobema oviforme*	Creeks and small rivers with moderate flow and sand/gravel substrates
FW Mollusk	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*	Small headwater streams with sand or mud substrates
FW Mollusk	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*	Headwater streams to rivers with moderate to high flow and unsilted gravel/ sand rubble, or boulder substrates

FW Mollusk		IV	c	Three-ridge valvata	*Valvata tricarinata*	Unknown habitat needs in Virginia but in other parts of the country this species is associated with aquatic vegetation
Insect	**FS**	I	a	Big stripetail stonefly	*Isoperla major*	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*	Small shady spring fed streams with mud bottoms
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*	Large rivers with rocks and moderate current
Insect	**FS**	II	c	Hubricht's cave beetle	*Pseudanophthalmus hubrichti*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Lobed roachfly	*Tallaperla lobata*	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect	**FS**	II	c	Maiden Spring cave beetle	*Pseudanophthalmus virginicus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens/ oak savanna and other open sunny habitats
Insect	**FS**	II	c	Saint Paul cave beetle	*Pseudanophthalmus sanctipauli*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Vicariant cave beetle	*Pseudanophthalmus vicarius*	Caves with clean abundant water flowing through the system
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*	Blue Ridge to the west - cliffs dry rocky slopes, talus, and exposed ridges
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*	High elevation forested areas west of the Shenandoah river
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred (Barbour and Davis 1969), though sometimes deeper locations are used (Schwartz and Schwartz 1981). Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*	Blue Ridge to the west - rock piles, rock slides and cliffs surrounded by forests
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests

Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*	Caves typically in limestone karst regions dominated by mature hardwood forests of hickory, beech, maple, and hemlock. Prefers cool, well-ventilated caves for hibernation; roost sites are often near cave entrances or in places where there is considerable air movement.
Other Aquatic Invertebrate	**FS**	I	c	A cave lumbriculid worm	*Stylodrilus beattiei*	Caves with clean abundant water flowing though the system
Other Aquatic Invertebrate	**FS**	II	c	A cave lumbriculid worm	*Spelaedrilus multiporus*	Caves with clean abundant water flowing through the system
Other Aquatic Invertebrate	**FS**	I	c	Chandler's planarian	*Sphalloplana chandleri*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius regulus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia armesi*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Big Cedar Creek millipede	*Brachoria falcifera*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FSST**	I	c	Brown supercoil	*Paravitrea septadens*	Deep moist leaf litter on wooded hillsides at the base of hills and ravines
Reptile		III	c	Cumberland slider	*Trachemys scripta troostii*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches
Reptile		III	c	Eastern black kingsnake	*Lampropeltis getula nigra*	This species is known to utilize various habitats, including dry rocky hills, open woods, dry prairies, stream valleys, and many other habitats
Reptile		IV	a	Northern map turtle	*Graptemys geographica*	Clear flowing water with gravel substrates
Reptile		IV	a	Spiny softshell	*Apalone spinifera spinifera*	Clean clear rivers with flowing water and sand substrates
Reptile		IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*	Warm streams with fast flows and rock and cobble substrates

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

CONSERVED LANDS IN THE CUMBERLAND PLATEAU PLANNING REGION

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to national forest to state parks and state wildlife management areas. Significant conservation assets, in terms of size, include:

- Jefferson National Forest,
- Clinch Mountain Wildlife Management Area,
- Breaks Interstate Park,
- Pinnacle State Natural Area Preserve,
- Cleveland Barrens State Natural Area Preserve, and
- Flannagan Reservoir.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

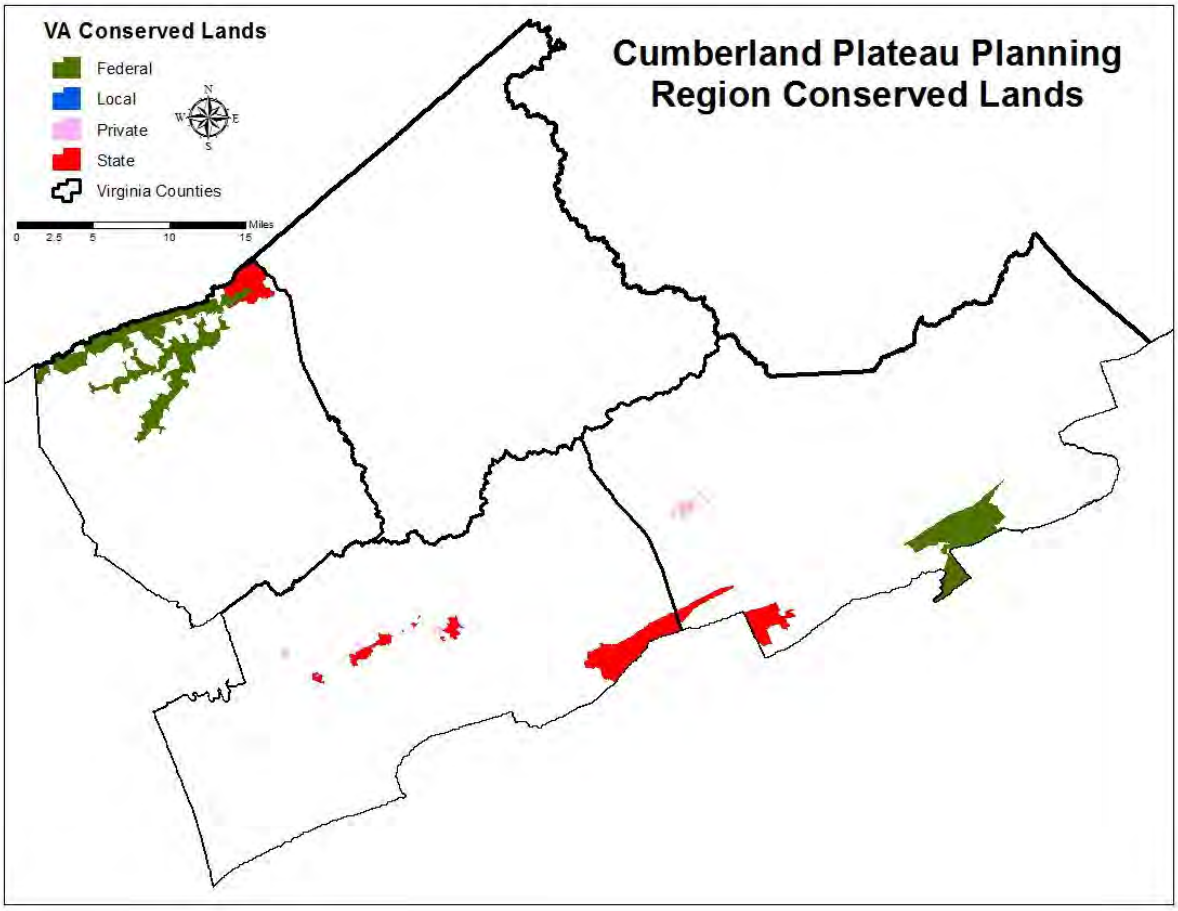

Figure 4. Conservation Lands in the Cumberland Plateau Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within the Cumberland Plateau Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Cumberland Plateau Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the Cumberland Plateau Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the Appalachians than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitat in the Cumberland Plateau Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Cumberland Plateau Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 3. Summary of Conservation Strategies and Actions for the Cumberland Plateau Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Increasing industrial and residential water consumption, sedimentation and pollutants; protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated and/ or forested buffers along streams and sinkholes; 2) Reforest erodible pastures; 3) Exclude livestock from streams and areas around sinkholes; 4) Improve pasture and loafing lot management to prevent tainted runoff; 5) Implement conservation tillage; 6) Establish storage facilities for animal waste and runoff retention ponds; 7) Prevent erosion after timber harvests; 8) Repair or replace failing septic systems and "straight pipes;" 9) Establish rain gardens; 10) Sweep streets; 11) Stabilize dirt roads; 12) Reclaim abandoned mine lands; 13) Work to prevent pet waste from entering the watershed; 14) Continue to identify impaired waters within the planning region; 15) Monitor and address invasive species impacts; and 16) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Big Cedar Creek, Clinch River, Dumps Creek, Indian Creek, Lewis Creek, Little River, Loops Creek, Swords Creek, Thompson Creek, Weaver Creek, Big Moccasin Creek, Laurel Creek, Tumbling Creek, Bluestone River, Guest River, Knox Creek, Pawpaw Creek, Lewis Creek, Upper Clinch River

Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species. 6) Work to create areas of young forest on public lands.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Cumberland Plateau Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2014). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for Hubricht's Cave Beetle and Burke's Garden Cave Beetle. Others species such as the Virginia big-eared and Indiana bats depend on karst habitat and are endangered throughout their range. Caves in the Cumberland Plateau Planning Region provide crucial winter habitat for some bat species.

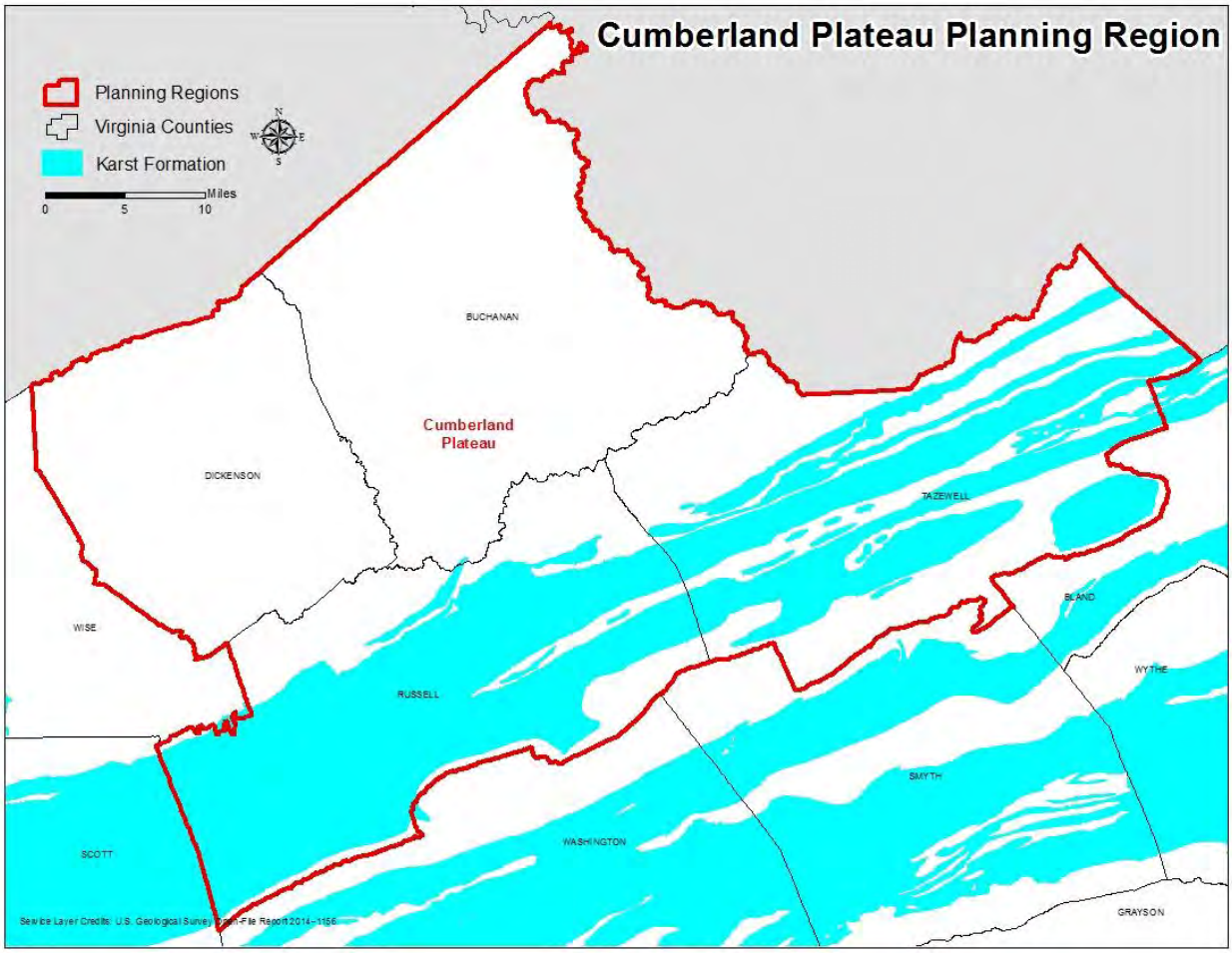

Figure 5. Karst Areas in the Cumberland Plateau Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems is affected

by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites. Development and resulting pollutant-laden runoff also negatively affect water quality (DCR 2008).

2. Altered Hydrology: Development, which also likely plays a role in degraded water quality in the areas where karst occurs, can also result in altered hydrology which can affect water quantity and flows. The amount of water flowing through a karst system is important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example,

if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change as with increased storm intensity will result in more stormwater runoff.

Maintain and Restore Wetland Habitats

A very small percentage of the Cumberland Plateau Planning Region is wetland habitat. The planning region has approximately 1,770 acres of non-tidal wetlands (0.15 percent of the region) (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for the Virginia rail.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When BMPs are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that results in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation. Examples of invasive species affecting these non-tidal wetlands include Japanese stilt grass and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Cumberland Plateau Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners

and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Cumberland Plateau Planning Region include those wetlands that would allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 6) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). The highest priorities for conservation and restoration exist in Russell County adjacent to already protected areas. Similar opportunities appear to be available in Tazwell County.

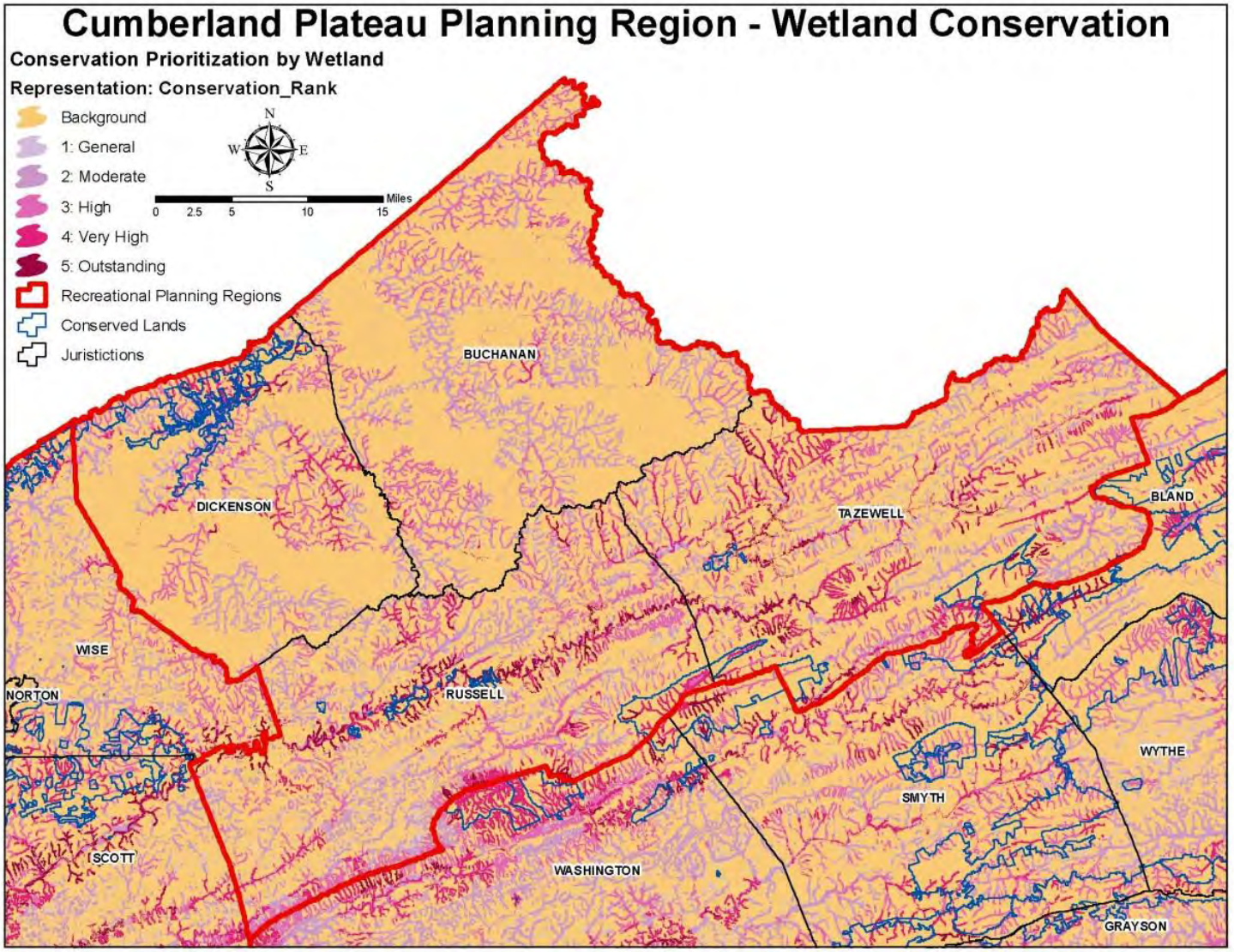

Figure 6. Wetland Conservation Priority Areas in Cumberland Plateau Planning Region (Weber and Bulluck 2014).

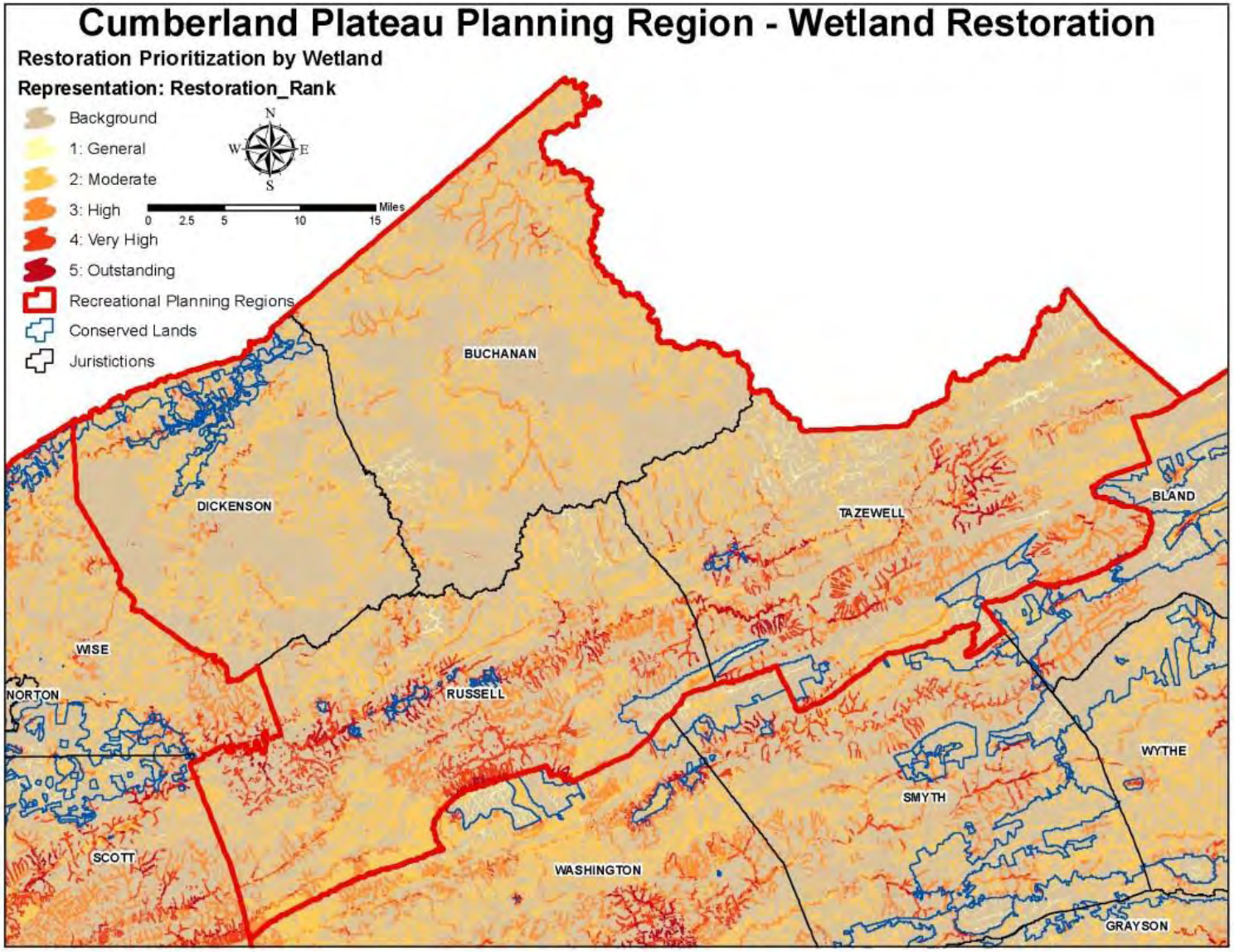

Figure 7. Wetland Restoration Priority Areas in Cumberland Plateau Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Cumberland Plateau Planning Region include cold and warm freshwater rivers, streams, and creeks. Much of the planning region is in the Clinch River watershed. Approximately 3,790 acres (0.32 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species. Example species within the planning region include the Clinch dace, brook trout, suckermouth minnow, Bluestone sculpin, Beartown perlodid stonefly, variegate darter, Big Sandy crayfish, sand shiner, and Clinch sculpin.

Threats

Aquatic and riparian habitats within the Cumberland Plateau Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Cumberland Plateau Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Cumberland Plateau has no areas with a high percentage of impervious surface cover; however, it still has some impervious surface cover (Figure 8).

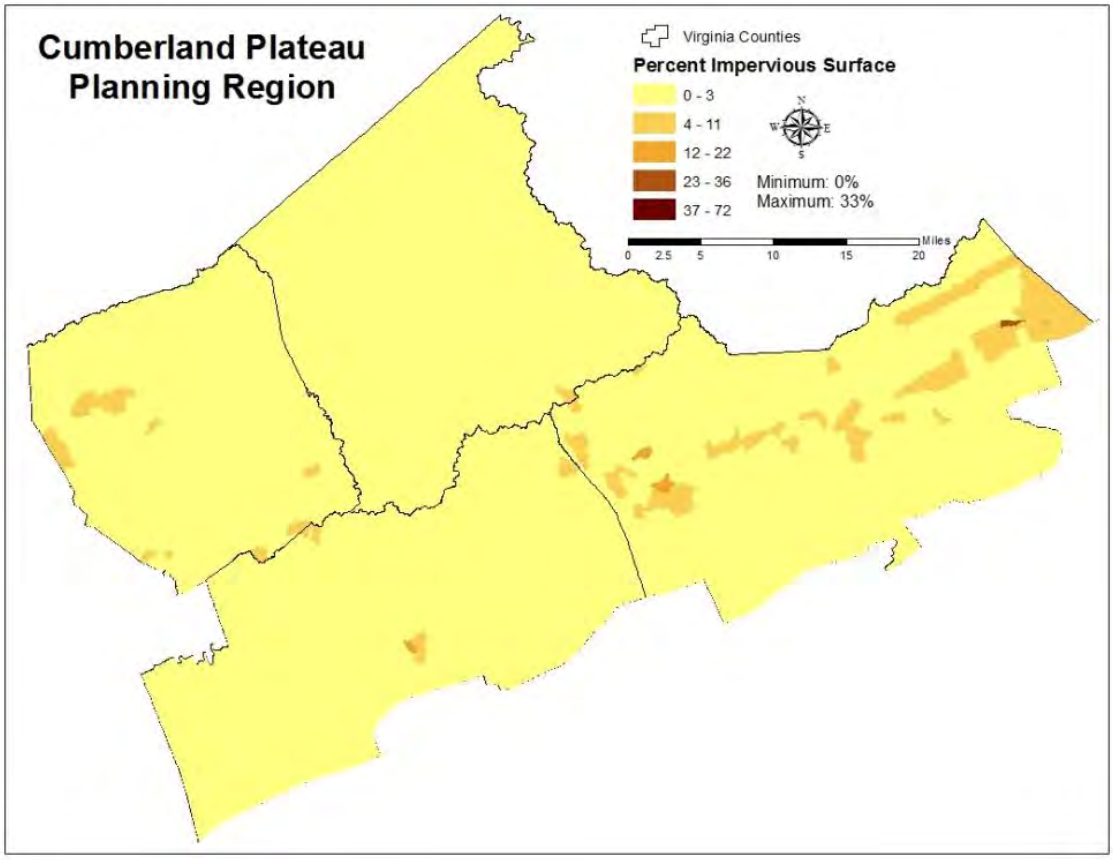

Figure 8. Impervious Surface Cover in Cumberland Plateau Planning Region (SARP 2014).

3. Catastrophic Spills: Catastrophic spills from industrial sites or road crossings can result in extensive loss of species and habitat in a short time period.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization and shoreline alteration and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

6. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating

aquatic species such as brook trout (Webb 2014). Streams may also become more alkaline due to mine runoff and underground mine pumping, which can also alter stream habitat.

7. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and air temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Big Cedar Creek, Clinch River, Dumps Creek, Indian Creek, Lewis Creek, Little River, Loops Creek, Swords Creek, Thompson Creek, and Weaver Creek (MapTech 2013a); Big Moccasin Creek, Laurel Creek, and Tumbling Creek (MapTech 2013b); Bluestone River (MapTech and New River-Highlands 2008a); Dumps Creek (MapTech and New River-Highlands 2008b); Guest River (Lonesome Pine Soil and Water Conservation District 2014); Knox Creek and PawPaw Creek (MapTech and New River-Highlands 2007); Lewis Creek (Blue Ridge Environmental Solutions 2010); and Upper Clinch River (Engineering Concepts 2007) (Figure 9).

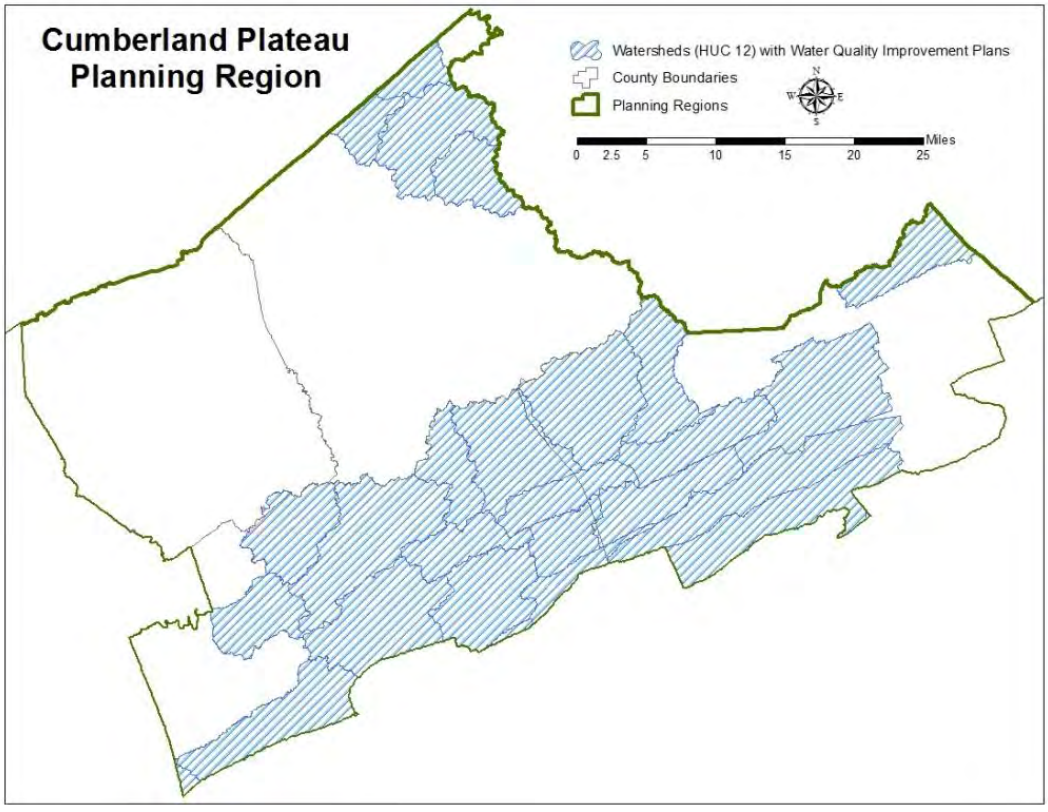

Figure 9. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated and/ or forested buffers along streams and sinkholes;
- Reforesting erodible pastures;
- Excluding livestock from streams and areas around sinkholes;
- Improving pasture and loafing lot management to prevent tainted runoff;
- Implementing conservation tillage;
- Establishing storage facilities for animal waste and runoff retention ponds;
- Preventing erosion after timber harvests;
- Repairing or replacing failing septic systems and “straight pipes” that deposit human waste into streams;
- Establishing rain gardens;
- Sweeping streets;
- Stabilizing dirt roads;
- Reclamation of abandoned mine lands; and
- Working to prevent pet waste from entering the watershed.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 10).

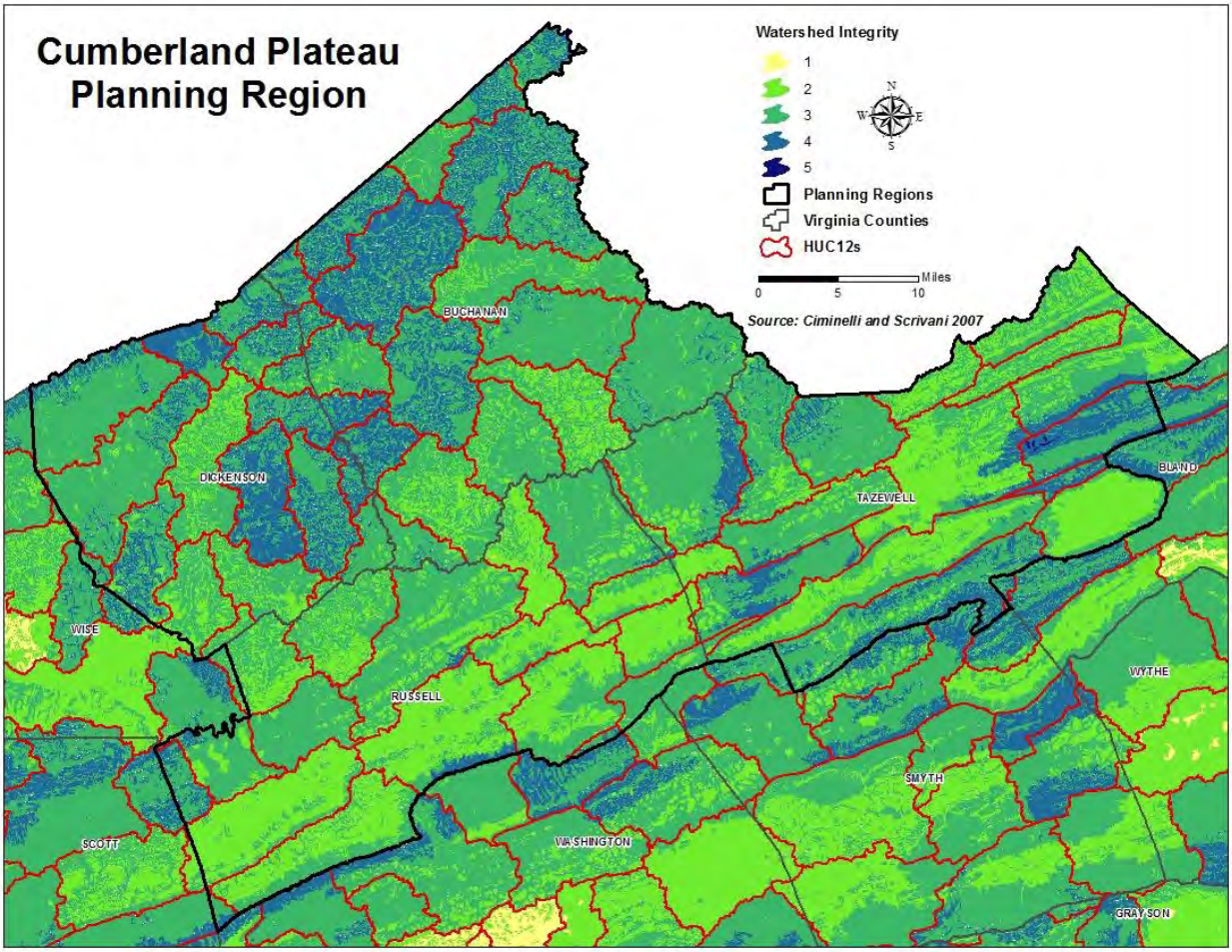

Figure 10. Watershed Integrity Model for Cumberland Plateau Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Cumberland Plateau Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Cumberland Plateau Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost 75 percent of the Cumberland Plateau Planning Region and are important for a broad range of species (Table 4). Within this forest type, young forests make up a specific age class of forest, loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods and conifers. Mixed hardwood and conifer and spruce fir forests help protect water resources within the region and provide habitat for species such as the mountain chorus frog, Cumberland Plateau salamander, Indiana Bat, yellow-bellied sapsucker, and a variety of other species.

Table 4. Forest Acreage Totals in Cumberland Plateau Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Spruce Fir	1,763.40	0.15%
Mixed Hardwood and Conifer	823,092.47	70.16%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Cumberland Plateau Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, then impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Energy development (wind energy and the potential for natural gas) could also degrade habitat and affect species composition and water quality.

2. Acid Rain: Although acid rain is less prevalent today than it once was, residual effects to the water and soil still remain and can affect forest health.

3. Invasive Species: Invasive plant species and pests are also a significant problem in this region. The hemlock wooly adelgid are harmful to conifer species like spruce and hemlock while the gypsy moth can have significant impacts on oaks during outbreak years (DOF 2014).

4. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia have curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

5. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the Cumberland Plateau Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Middle Clinch River Watershed Implementation*

Plan developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Big Cedar Creek, Clinch River, Dumps Creek, Indian Creek, Lewis Creek, Little River, Loops Creek, Swords Creek, Thompson Creek, and Weaver Creek watersheds to help decrease sediment run off as well as provide wildlife habitat (MapTech 2013a). Similar actions are recommended for the Upper Clinch River as well (Engineering Concepts 2007).

Several agencies, including DGIF, the NRCS, DOF, and the USFS advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Cumberland Plateau Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for

Action Plan species. Open habitats are often comprised of post- agricultural lands, glades, and barrens and make up approximately 39,335 acres (3.35 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These areas provide habitat for the golden winged warbler.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open and young forest species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF website 2014). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentives Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse composition of vegetation species (Craine et al. 2012). It is important to note that if there is extended

severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-native species and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of open habitats will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and

- Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Cumberland Plateau Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Protecting the quantity and quality of water.
- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN CUMBERLAND PLATEAU PLANNING REGION

Complete SGCN list for the Cumberland Plateau Planning Region (SGCN=165). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibians		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibians		III	a	Common mudpuppy	*Necturus maculosus maculosus*
Amphibians		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*
Amphibians	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibians		II	b	Green salamander	*Aneides aeneus*
Amphibians		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibians		II	a	Mountain chorus frog	*Pseudacris brachyphona*
Amphibians		II	c	Southern zigzag salamander	*Plethodon ventralis*
Birds		II	a	American black duck	*Anas rubripes*
Birds		II	a	American woodcock	*Scolopax minor*
Birds		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Birds		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Birds		IV	a	Brown thrasher	*Toxostoma rufum*
Birds		IV	b	Canada warbler	*Wilsonia canadensis*
Birds		II	a	Cerulean warbler	*Dendroica cerulea*
Birds		IV	b	Chimney swift	*Chaetura pelagica*
Birds		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Birds		IV	a	Eastern meadowlark	*Sturnella magna*
Birds		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Birds		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Birds		IV	b	Eastern wood-pewee	*Contopus virens*
Birds		IV	a	Field sparrow	*Spizella pusilla*
Birds		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Birds		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Birds		IV	a	Gray catbird	*Dumetella carolinensis*
Birds		IV	b	Green heron	*Butorides virescens*
Birds		III	a	Kentucky warbler	*Oporornis formosus*

Birds	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Birds		III	a	Northern bobwhite	*Colinus virginianus*
Birds		III	a	Northern harrier	*Circus cyaneus*
Birds		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Birds	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Birds		IV	b	Rusty blackbird (migrant)	*Euphagus carolinus*
Birds		II	b	Swainson's warbler	*Limnothlypis swainsonii*
Birds		IV	b	Wood thrush	*Hylocichla mustelina*
Birds		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Birds		IV	a	Yellow-breasted chat	*Icteria virens*
Crustaceans	**FSSE**	I	c	Big Sandy Crayfish	*Cambarus veteranus*
Crustaceans		III	b	Longclaw crayfish	*Cambarus buntingi*
Crustaceans		III	c	Reticulate crayfish	*ORCONECTES ERICHSONIANUS*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish	**FS**	I	b	Ashy darter	*Etheostoma cinereum*
Fish		IV	c	Black sculpin	*Cottus baileyi*
Fish		IV	c	Blotched chub	*Erimystax insignis*
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*
Fish	**FS**	III	c	Bluestone sculpin	*Cottus sp. 1*
Fish		IV	c	Brook silverside	*Labidesthes sicculus*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*
Fish		III	c	Channel darter	*Percina copelandi*
Fish	**FS**	I	a	Clinch dace	*Chrosomus sp. cf. saylori*
Fish	**FS**	III	c	Clinch sculpin	*Cottus sp. 4*
Fish		IV	c	Dusky darter	*Percina sciera*
Fish	**FESE**	I	a	Duskytail darter	*Etheostoma percnurum*
Fish	**ST**	IV	c	Emerald shiner	*Notropis atherinoides*
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*
Fish	**FS**	III	c	Holston sculpin	*Cottus sp. 5*
Fish		IV	c	Logperch	*Percina caprodes*
Fish		III	c	Mirror shiner	*Notropis spectrunculus*
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*
Fish		IV	c	Mountain madtom	*Noturus eleutherus*
Fish		IV	c	Mountain shiner	*Lythrurus lirus*

Fish		IV	c	New River shiner	*Notropis scabriceps*
Fish		IV	c	Northern studfish	*Fundulus catenatus*
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*
Fish	**ST**	IV	c	Paddlefish	*Polyodon spathula*
Fish		II	c	Popeye shiner	*Notropis ariommus*
Fish		III	b	River redhorse	*Moxostoma carinatum*
Fish		IV	c	Sand shiner	*Notropis stramineus*
Fish		III	b	Sauger	*Sander canadensis*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
Fish	**FTST**	I	c	Slender chub	*Erimystax cahni*
Fish		IV	c	Speckled darter	*Etheostoma stigmaeum*
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*
Fish	**ST**	III	c	Steelcolor shiner	*Cyprinella whipplei*
Fish		IV	c	Stonecat	*Noturus flavus*
Fish		IV	c	Suckermouth minnow	*Phenacobius mirabilis*
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*
Fish		IV	c	Tangerine darter	*Percina aurantiaca*
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*
Fish	**SE**	I	a	Variegate darter	*Etheostoma variatum*
Fish		III	c	Wounded darter	*Etheostoma vulneratum*
Fish	**FTST**	I	a	Yellowfin madtom	*Noturus flavipinnis*
FW Mollusks	**FESE**	I	a	Appalachian monkeyface	*Quadrula sparsa*
FW Mollusks	**FESE**	I	a	Birdwing pearlymussel	*Lemiox rimosus*
FW Mollusks	**ST**	III	a	Black sandshell	*Ligumia recta*
FW Mollusks		III	c	Brown walker	*Pomatiopsis cincinnatiensis*
FW Mollusks	**FESE**	I	b	Cracking pearlymussel	*Hemistena lata*
FW Mollusks		IV	a	Creeper	*Strophitus undulatus*
FW Mollusks	**FESE**	I	a	Cumberland bean	*Villosa trabalis*
FW Mollusks		IV	a	Cumberland moccasinshell	*Medionidus conradicus*
FW Mollusks	**FESE**	I	a	Cumberland monkeyface	*Quadrula intermedia*
FW Mollusks	**FESE**	I	a	Cumberlandian combshell	*Epioblasma brevidens*
FW Mollusks	**SE**	III	b	Deertoe	*Truncilla truncata*
FW Mollusks	**FESE**	I	a	Dromedary pearlymussel	*Dromus dromas*
FW Mollusks	**SE**	III	a	Elephant ear	*Elliptio crassidens*
FW Mollusks		II	c	Elktoe	*Alasmidonta marginata*
FW Mollusks	**FESE**	I	a	Fanshell	*Cyprogenia stegaria*
FW Mollusks	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*

FW Mollusks	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*
FW Mollusks	**ST**	IV	b	Fragile papershell	*Leptodea fragilis*
FW Mollusks	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*
FW Mollusks		III	a	Longsolid	*Fusconaia subrotunda*
FW Mollusks		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*
FW Mollusks	**FESE**	I	a	Oyster mussel	*Epioblasma capsaeformis*
FW Mollusks	**ST**	IV	b	Pimple back	*Quadrula pustulosa pustulosa*
FW Mollusks		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusks	**FESE**	I	a	Purple bean	*Villosa perpurpurea*
FW Mollusks	**FSSE**	II	c	Purple liliput	*Toxolasma lividus*
FW Mollusks	**FSSE**	II	a	Pyramid pigtoe	*Pleurobema rubrum*
FW Mollusks	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*
FW Mollusks		IV	c	Seep mudalia	*Leptoxis dilatata*
FW Mollusks	**FPST**	II	a	Sheepnose	*Plethobasus cyphyus*
FW Mollusks	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*
FW Mollusks	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*
FW Mollusks	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*
FW Mollusks	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*
FW Mollusks	**FPSE**	I	b	Spectaclecase	*Cumberlandia monodonta*
FW Mollusks	**FSST**	III	a	Spiny riversnail	*Io fluvialis*
FW Mollusks		III	a	Tennessee clubshell	*Pleurobema oviforme*
FW Mollusks	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*
FW Mollusks	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*
FW Mollusks		IV	c	Three-ridge valvata	*Valvata tricarinata*
Insects	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insects	**FS**	I	a	Big stripetail stonefly	*Isoperla major*
Insects	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*
Insects	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*
Insects		II	c	Green-faced clubtail	*Gomphus viridifrons*
Insects	**FS**	II	c	Hubricht's cave beetle	*Pseudanophthalmus hubrichti*
Insects	**FS**	II	c	Lobed roachfly	*Tallaperla lobata*
Insects	**FS**	II	c	Maiden Spring cave beetle	*Pseudanophthalmus virginicus*
Insects	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insects	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insects	**FS**	II	c	Saint Paul cave beetle	*Pseudanophthalmus sanctipauli*
Insects	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*
Insects	**FS**	II	c	Vicariant cave beetle	*Pseudanophthalmus vicarius*

Mammals		IV	c	Allegheny woodrat	*Neotoma magister*
Mammals		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammals		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammals		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammals	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammals	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammals		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammals	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Aquatic Invertebrates	**FS**	I	c	A cave lumbriculid worm	*Stylodrilus beattiei*
Other Aquatic Invertebrates	**FS**	II	c	A cave lumbriculid worm	*Spelaedrilus multiporus*
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius regulus*
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia armesi*
Other Terrestrial Invertebrate		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*
Other Terrestrial Invertebrate	**FS**	II	c	Big Cedar Creek millipede	*Brachoria falcifera*
Other Terrestrial Invertebrate	**FSST**	I	c	Brown supercoil	*Paravitrea septadens*
Other Aquatic Invertebrates	**FS**	I	c	Chandler's planarian	*Sphalloplana chandleri*
Reptiles		III	c	Cumberland slider	*Trachemys scripta troostii*
Reptiles		III	c	Eastern black kingsnake	*Lampropeltis getula nigra*
Reptiles		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptiles		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptiles		IV	a	Northern map turtle	*Graptemys geographica*
Reptiles		IV	a	Queen snake	*Regina septemvittata*
Reptiles		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptiles		IV	a	Spiny softshell	*Apalone spinifera spinifera*
Reptiles		IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*
Reptiles	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

10. George Washington Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the State or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

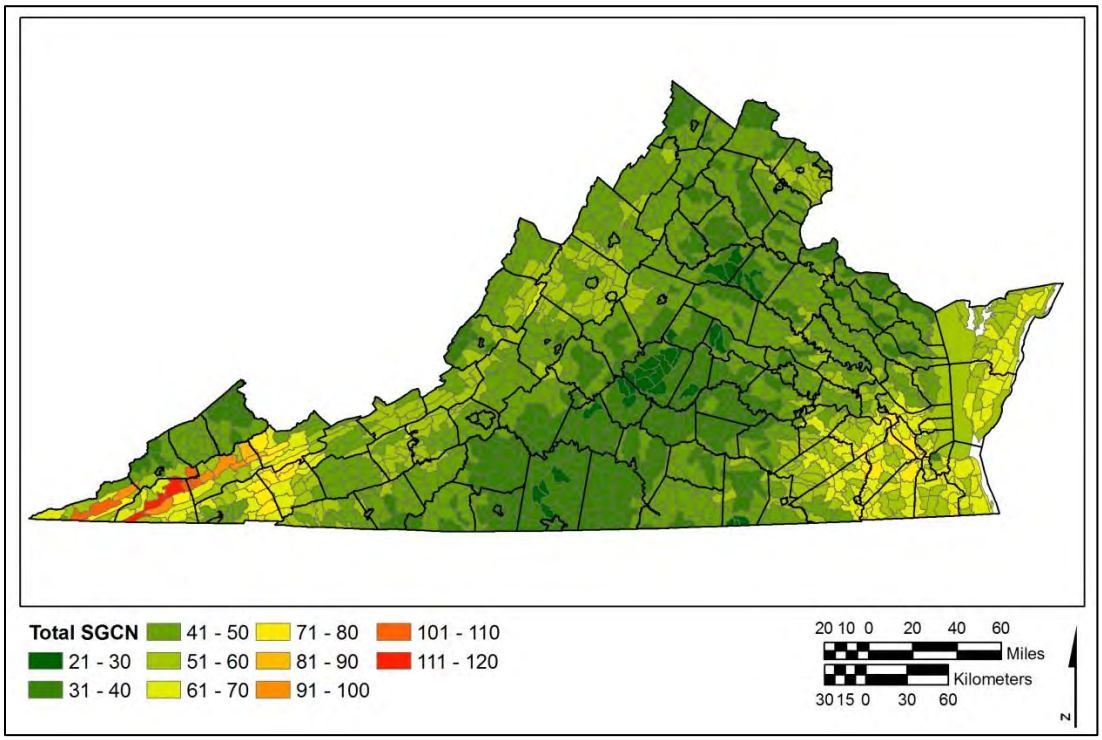

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

George Washington Planning Region Summary Overview

The George Washington Planning Region consists of 916,270 acres (1,432 square miles) and includes the counties of Caroline, King George, Spotsylvania, and Stafford, and the city of Fredericksburg. The human population in this planning region is estimated to be over 352,000 people. All counties in this planning region are projected to experience intense population growth by 2030, especially Caroline and Spotsylvania counties (U.S. Census Bureau 2015). Much of this growth is due to their proximity to the Washington, DC metro area.

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow, especially in planning regions such as George Washington near a large metropolitan area. This planning region is important to the conservation of various SGCN such as the common rainbow snake, American bittern, and dwarf wedgemussel, among others. The region also includes a variety of habitat types, including mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, and tidally influenced and freshwater streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered in development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

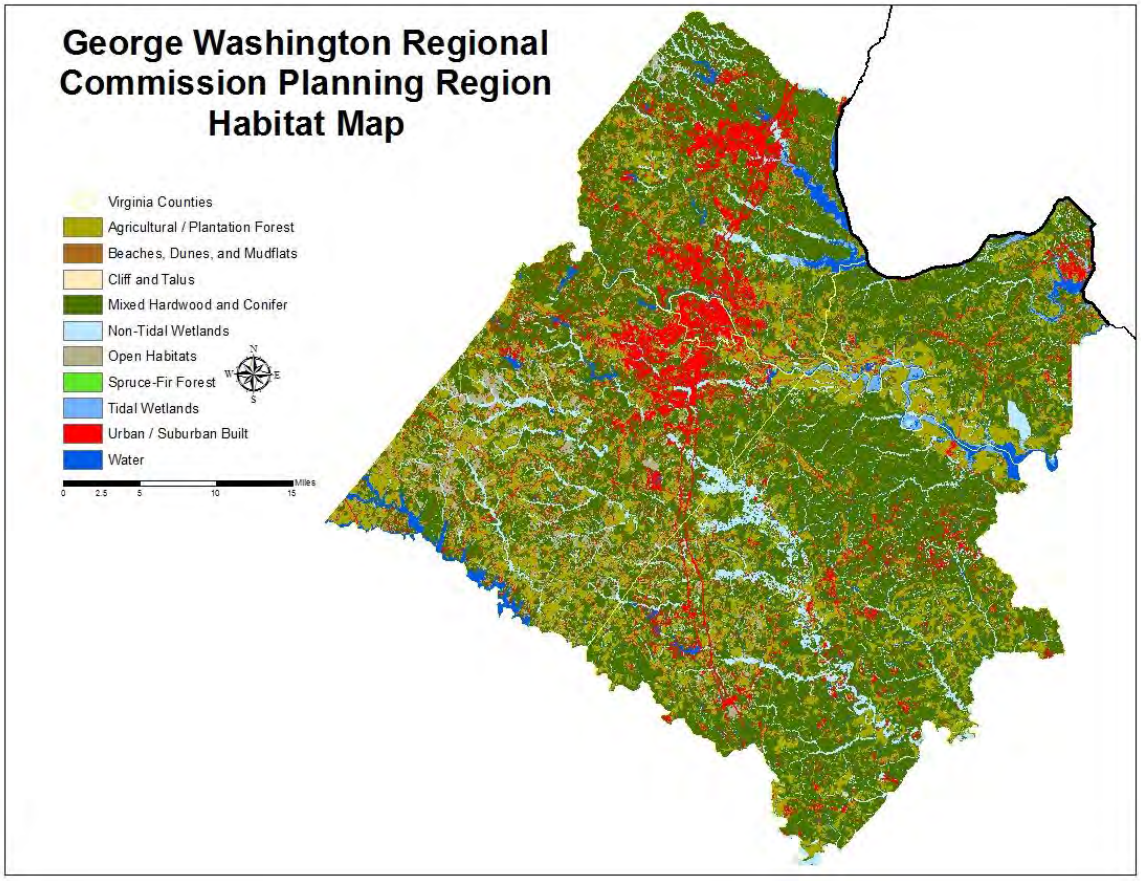

Figure 2. George Washington Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 76 are believed to either occur, or have recently occurred, within the George Washington Planning Region (Appendix A). Of these 76 species, ***30 SGCN are dependent upon habitats provided within the George Washington Planning Region (Table 2). These species constitute the priority SGCN for the planning region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 30 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	2
IIIa	5
IIIb	1
IIIc	1
IVa	13
IVb	5
IVc	3

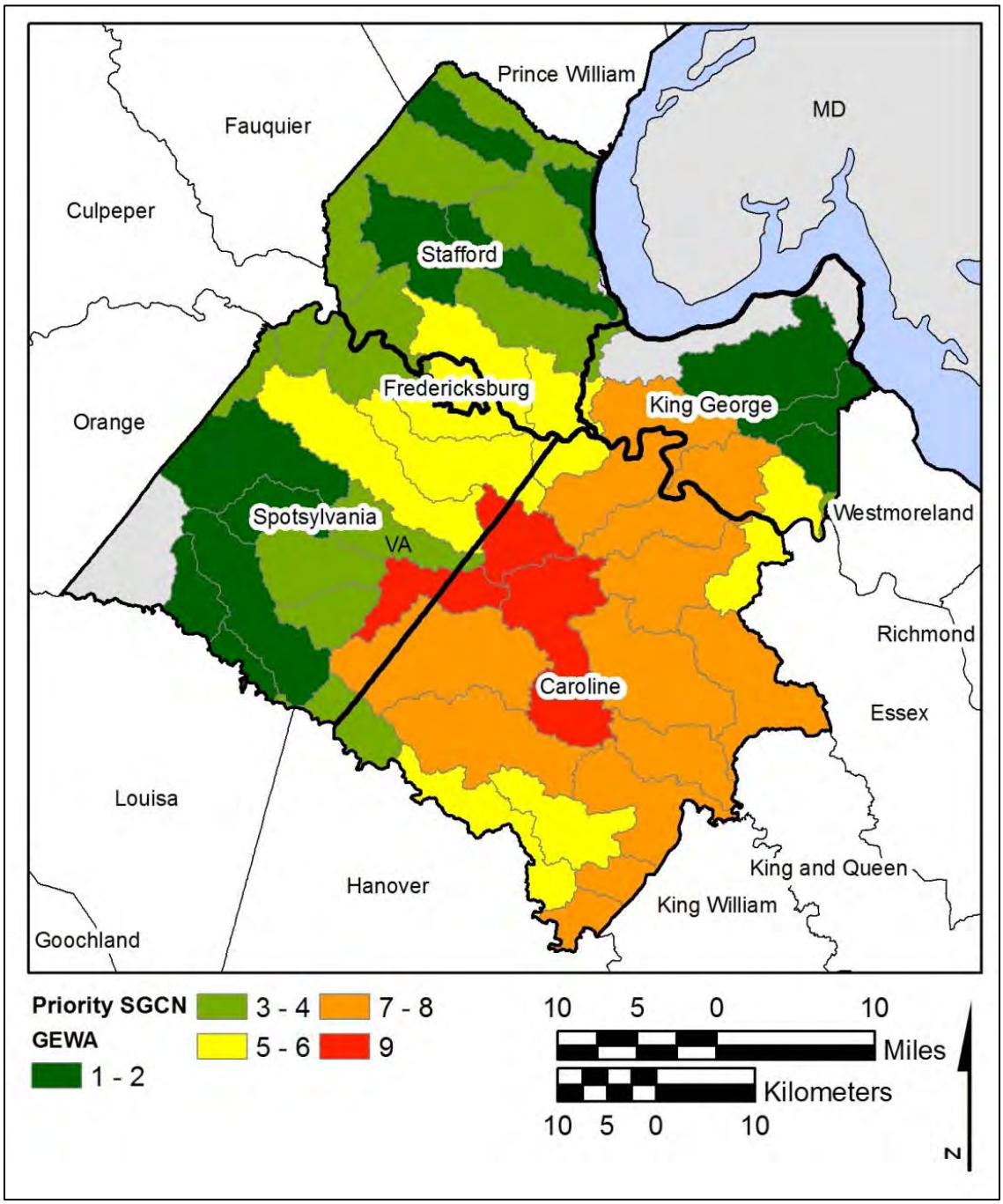

Figure 3. Priority SGCN Density in the George Washington Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within the George Washington Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*	Freshwater wetlands with sphagnum moss
Amphibian		IV	a	Greater siren	*Siren lacertina*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate

Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria viren*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Fish		IV	c	American brook lamprey	*Lampetra appendix*	Requires clear flowing water but can tolerate a range of temperatures and substrates
Fish		IV	a	American shad	*Alosa sapidissima*	Large unfragmented migratory rivers for spawning
Fish		I	a	Bridle shiner	*Notropis bifrenatus*	Slow clear water with aquatic vegetation
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*	Warm small streams with slow flows and sand/ silt substrates
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*	Swamps, ponds, and slow moving water
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*	Clean warm streams and rivers with low to moderate current and unsilted substrates
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*	Riparian forest - eel obligate

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC)

Conserved Lands in George Washington Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks, forests, and wildlife management areas to National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Rappahannock River Valley National Wildlife Refuge,
- Fredericksburg and Spotsylvania National Military Park,
- Lands End Wildlife Management Area,
- Mattaponi Wildlife Management Area,
- Pettigrew Wildlife Management Area,
- Lake Anna State Park,
- Widewater State Park,
- Prince William Forest Park,
- Crow's Nest Natural Area Preserve
- Chotank State Natural Area Preserve, and
- Caledon State Natural Area.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities. Additionally, various military installations, such as Marine Corps Base Quantico and Fort A.P. Hill, support viable habitats and wildlife populations.

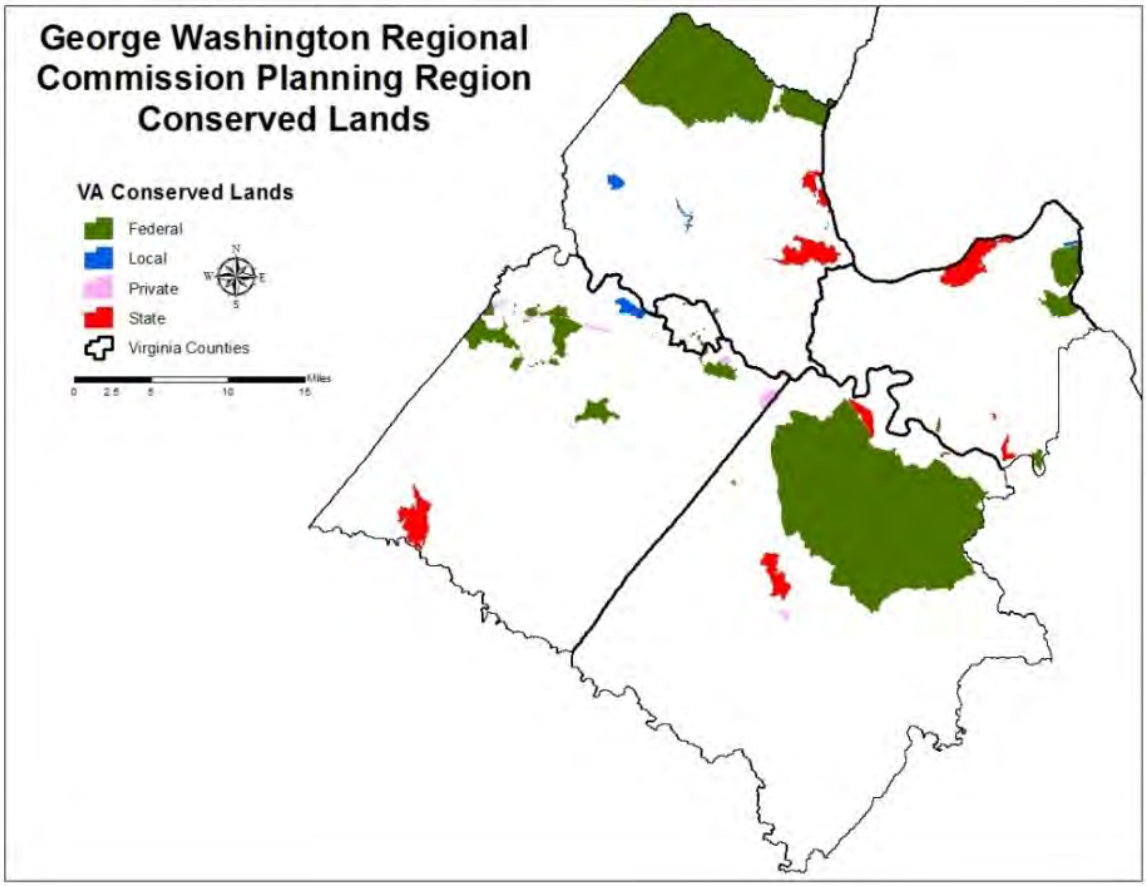

Figure 2. Conservation Lands in the George Washington Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within George Washington Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks specific to these lands held in conservation. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in George Washington Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the George Washington Planning Region Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models developed

for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Because George Washington Planning Region is located further inland and much of the area along the Potomac is protected, impacts from sea-level rise will likely be less intense than in other coastal regions of the state (VIMS, 2013). However, over time, it is possible areas along the Potomac will experience some effects from sea-level rise and storm surge from more intense storm events (VIMS, 2013). A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events are expected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are likely to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013). VIMS also estimates that given these projections, George Washington Planning Region has approximately 5 miles of road that will likely be vulnerable to sea-level rise (in King George and Caroline counties) (VIMS 2013).

Conservation Threats and Actions for Wildlife in the George Washington Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many George Washington Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for George Washington Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, climate change, non-native and exotic invasive species, predators	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish riparian vegetative buffers along waterways; 2) Reforest erodible cropland and pastures; 3) Establish waste storage facilities (such as dairy lagoons or waste sheds) to better manage animal waste and prevent flow into the river; 4) Establish retention ponds, impoundments, or other features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands; 5) Implement projects to slow urban storm water flowing into steams such as vegetative buffers, reducing impervious surface, rain gardens, and low impact development techniques; 6) Repair or replace failing septic systems and pit privies; 7) Work to prevent pet and kennel waste from entering waterways; 8) Identify additional impaired waters within planning region; 9) Restore aquatic connections;10) Monitor and address invasive species impacts; and 11) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, land conversion/ alteration, invasive species, water withdrawals, climate change	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; Sustain sport fisheries and recreation opportunities; contribute to clean water supply	Deep Run, Fairview Beach, Plentiful Creek
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; and ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter river systems	Areas supporting SGCN that are not already protected

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the George Washington Planning Region. In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes are the most common wetland type in this area, and they provide valuable habitats for SGCN such as the carpenter frog, mud sunfish, and a variety of other species (Table 4).

Table 4. Wetland Acreage in the George Washington Planning Region (Anderson et al. 2013).

Wetland Type	Acreage	Percent of Planning Region
Non-Tidal Wetland	70,720.88	7.72%
Tidal Wetland	7,419.90	0.81%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to tidal and non-tidal wetlands is conversion to other uses and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of tidal wetland habitat through damage or loss to wetland vegetation. Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites,* purple loosestrife, Japanese stilt grass, and exotic invertebrates.

4. Climate Change: As sea levels rise, marshes can be inundated and convert to shallow open water habitats. Shallow open water habitats and salt marshes likely will not support the same vegetative composition as the non-tidal and tidal wetlands in this planning region, affecting the wildlife species that depended on these habitats (CCSP 2009). Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species (CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the George Washington Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option to for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, rock sills, bank grading, or other more natural methods, living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate inland as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands also is important to protect health of the existing wetlands as well as to provide a potential inland migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the George Washington Planning Region include those wetlands that are inland of tidal wetlands that may provide some opportunity for inland migration as sea levels rise. These more inland areas also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). Some areas with high priority wetlands for conservation are adjacent to already protected areas such as in King George and Spotsylvania counties.

High priority restoration potential exists in King George and Caroline, and opportunities to restore wetlands adjacent to already conserved lands appear greatest in Stafford County.

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

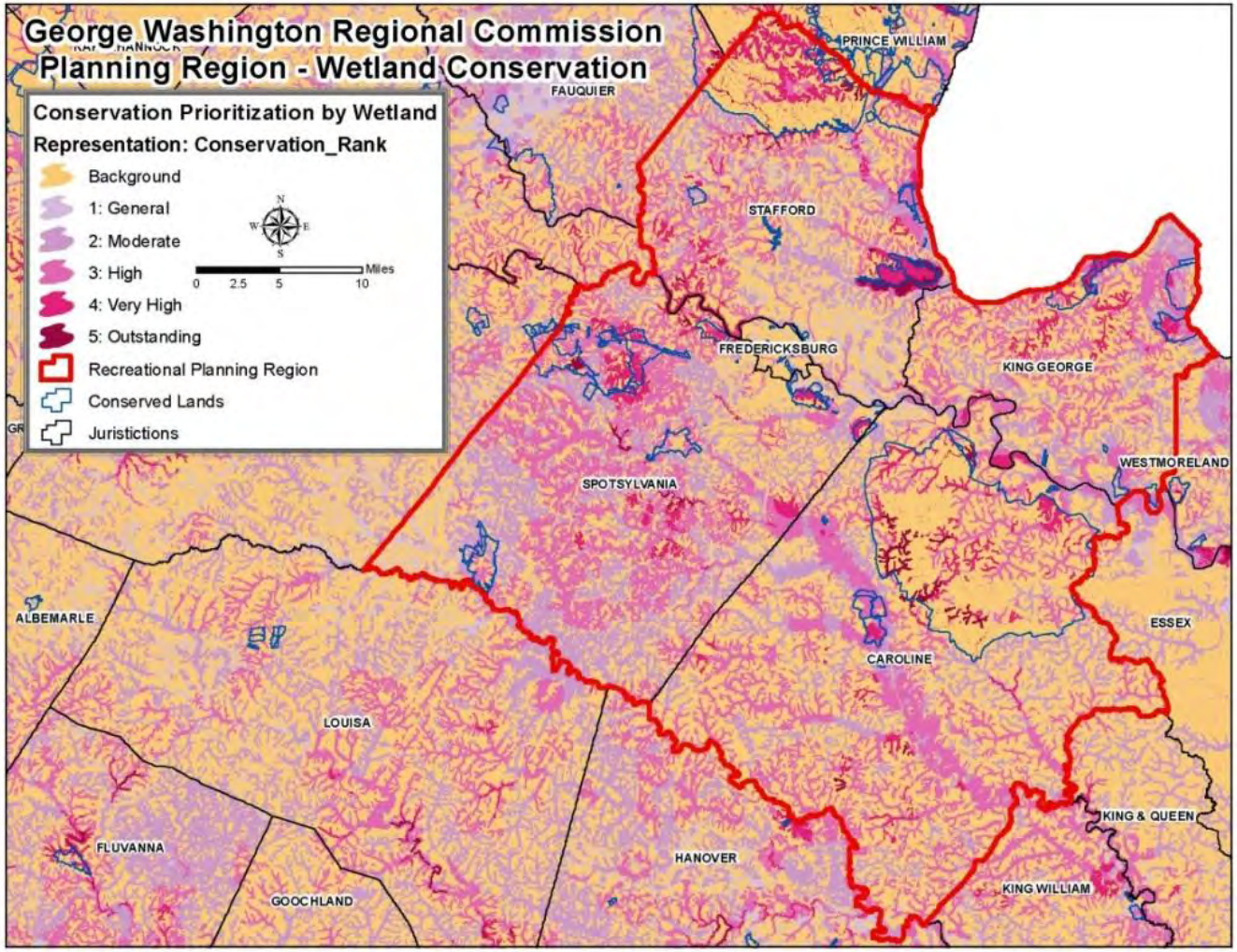

Figure 5. Wetland Conservation Priorities in George Washington Planning Region (Weber and Bulluck 2014).

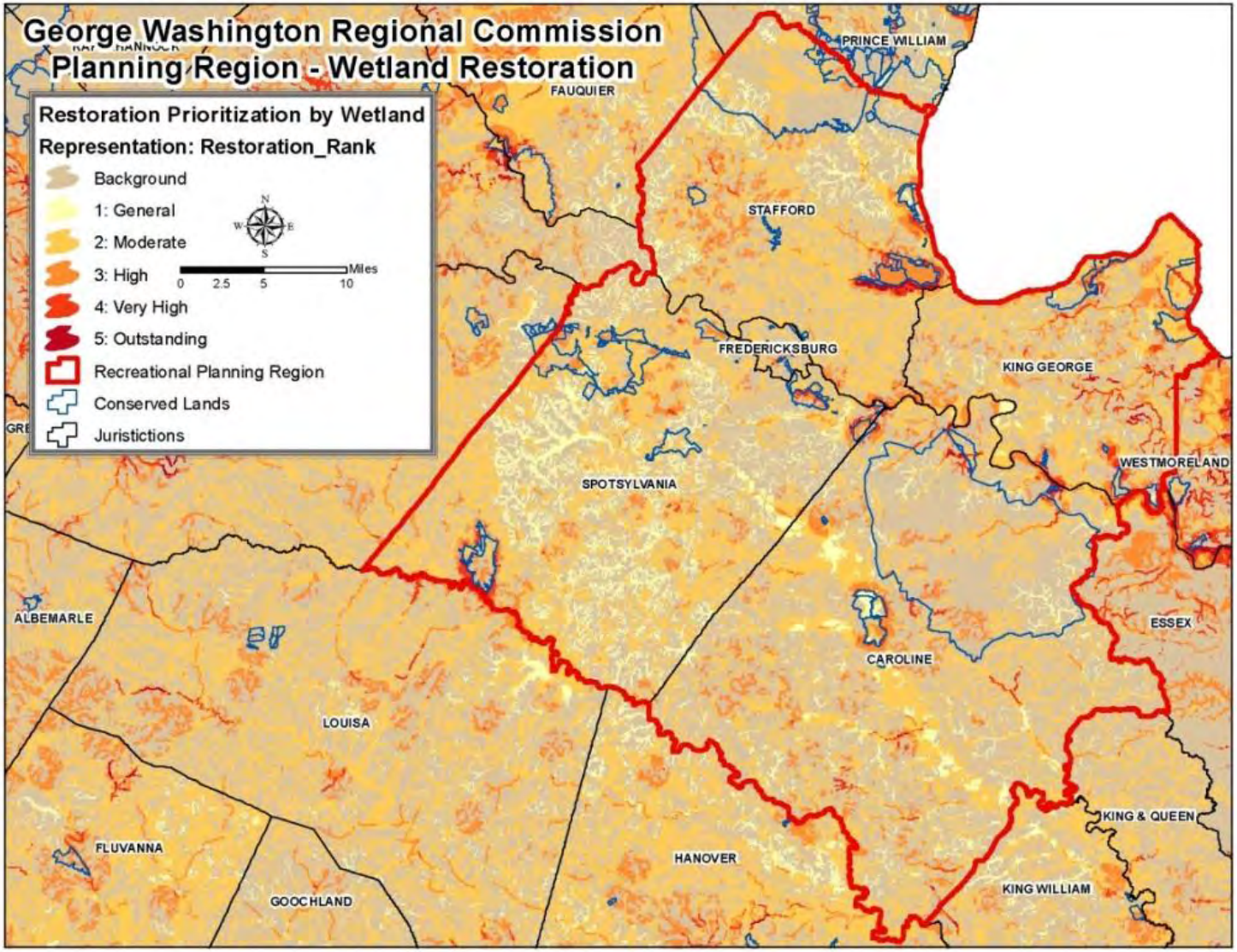

Figure 6. Wetland Restoration Priorities in George Washington Planning Region (Weber and Bulluck 2014).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the George Washington Planning Region include tidal and non-tidal freshwater creeks and streams. The majority of the planning region falls within the Rappahannock River Watershed. Approximately 31,700 acres (3.5 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include the dwarf wedgemussel, greater siren, eastern lesser siren, least brook lamprey, American brook lamprey, and a variety of other species.

Threats

Aquatic and riparian habitats within the George Washington Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the George Washington Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area (Figure 9). In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Much of the George Washington Planning Region has a low percentage of impervious surface cover; however, the larger population centers have a higher percentage of impervious surfaces (Figure 7).

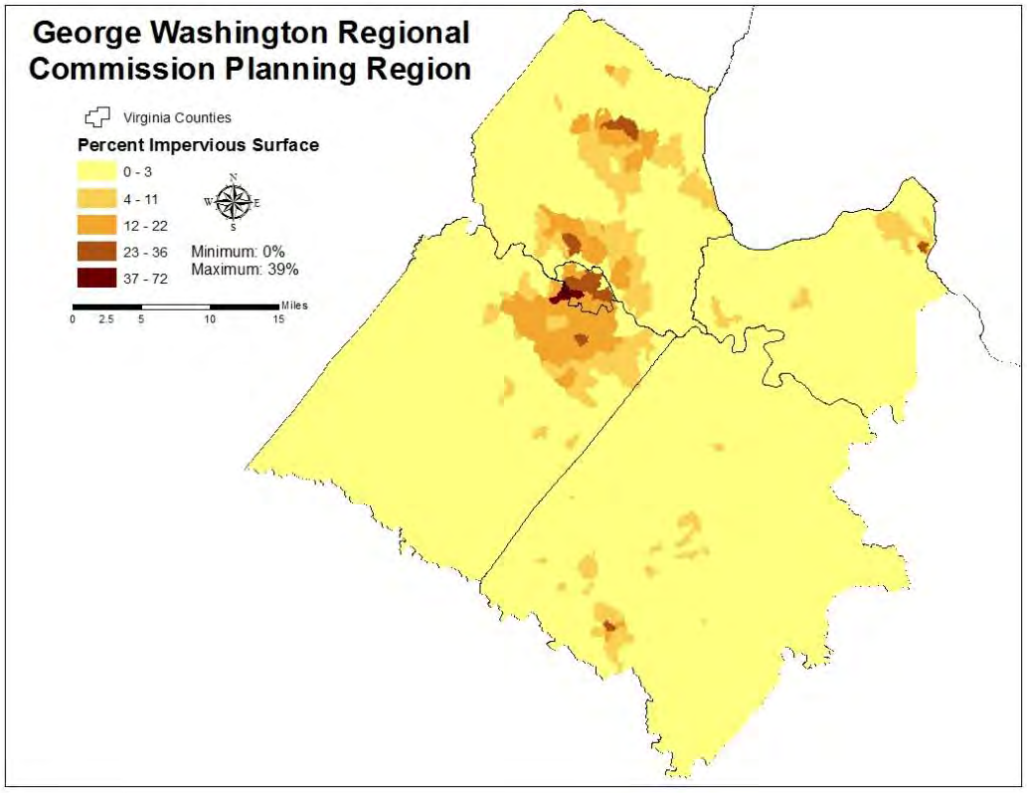

Figure 7. Impervious Surface Cover in George Washington Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within George Washington Planning Region include invasive species such as blue catfish, snakeheads, Asian carp (e.g., big head carp and grass carp) that either consume native species or aquatic vegetation, altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the aquifer that could degrade the quality of both subterranean and surface water.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Deep Run (Engineering Concepts 2006), Fairview Beach (ICPRB 2014), and Plentiful Creek (Blue Ridge Environmental Solutions, Inc. 2011) (Figure 8).

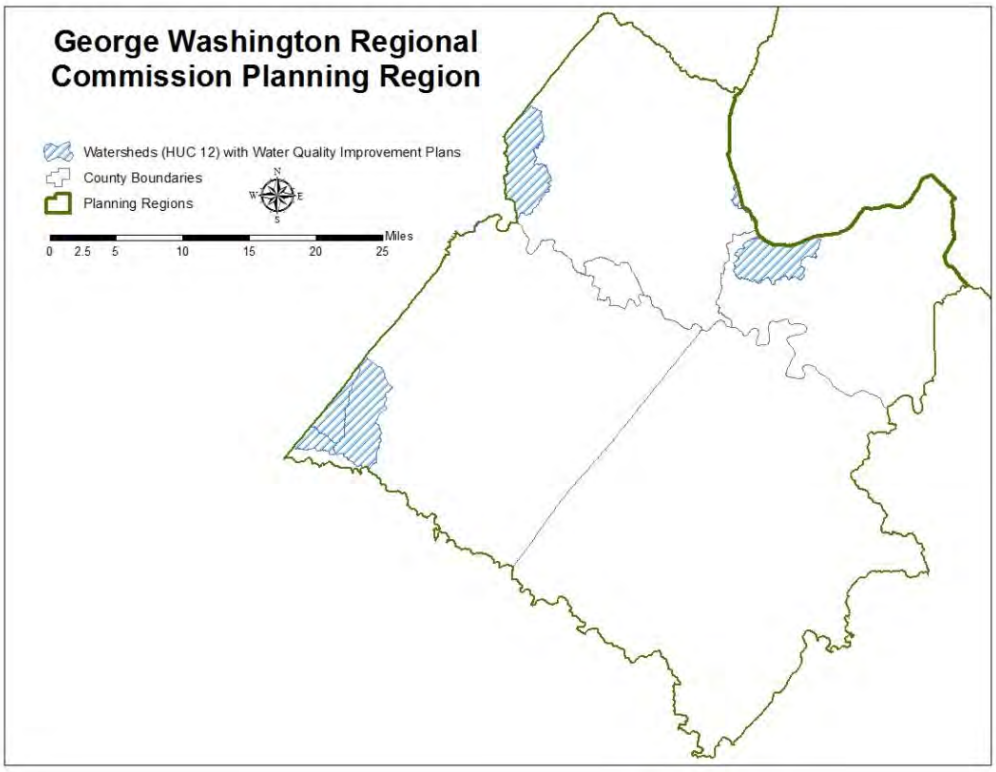

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing riparian vegetative buffers along waterways;
- Reforesting erodible cropland and pastures;
- Establishing waste storage facilities (such as dairy lagoons or waste sheds) to better manage animal waste and prevent flow into the river;
- Establishing retention ponds, impoundments, or other features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands;
- Implement projects to slow storm water flowing into steams such as vegetative buffers, reducing impervious surface, rain gardens, and low impact development techniques;
- Repairing or replacing failing septic systems and pit privies; and
- Working to prevent pet and kennel waste from entering waterways.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity

Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

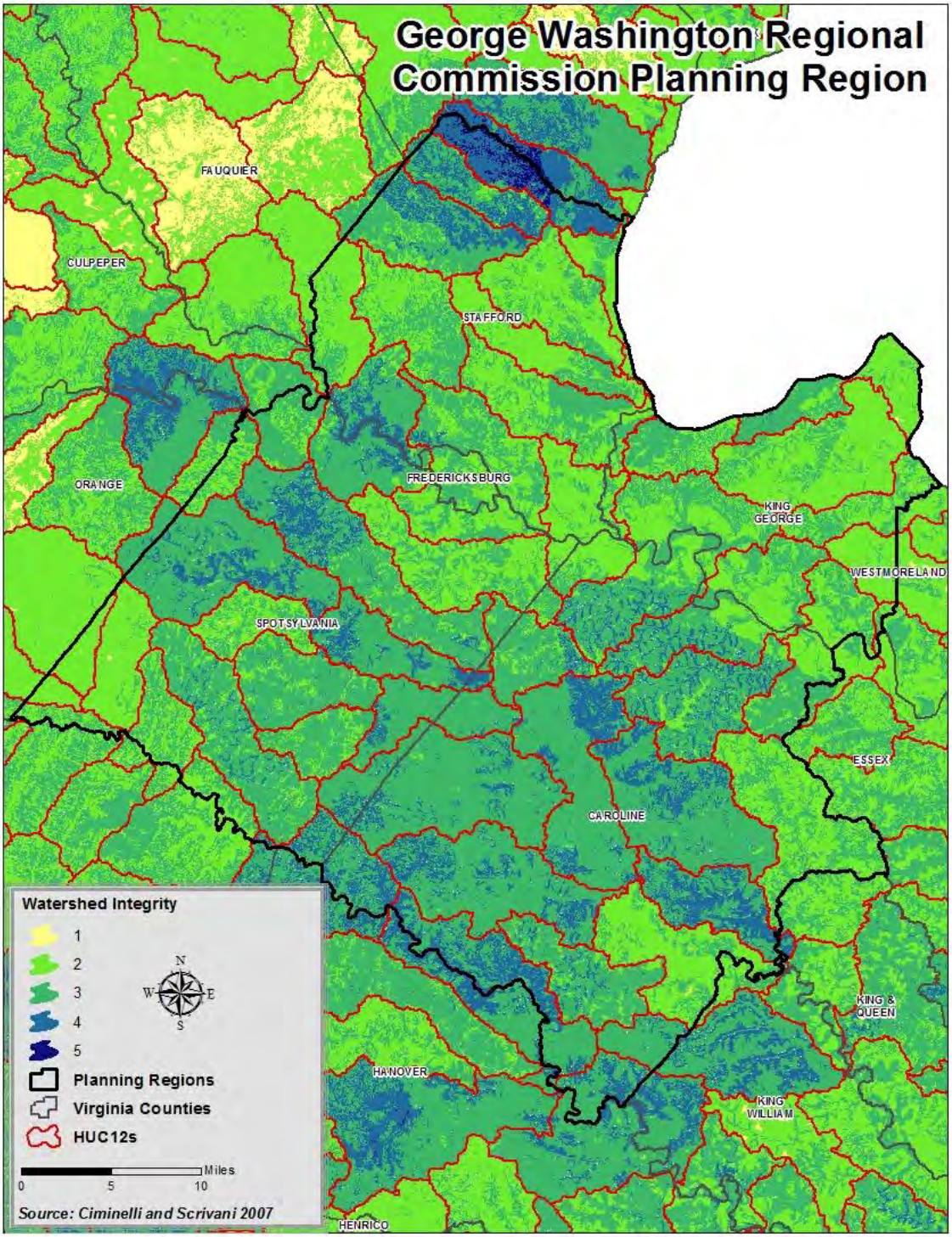

Figure 9. Watershed Integrity Model for George Washington Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the George Washington Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

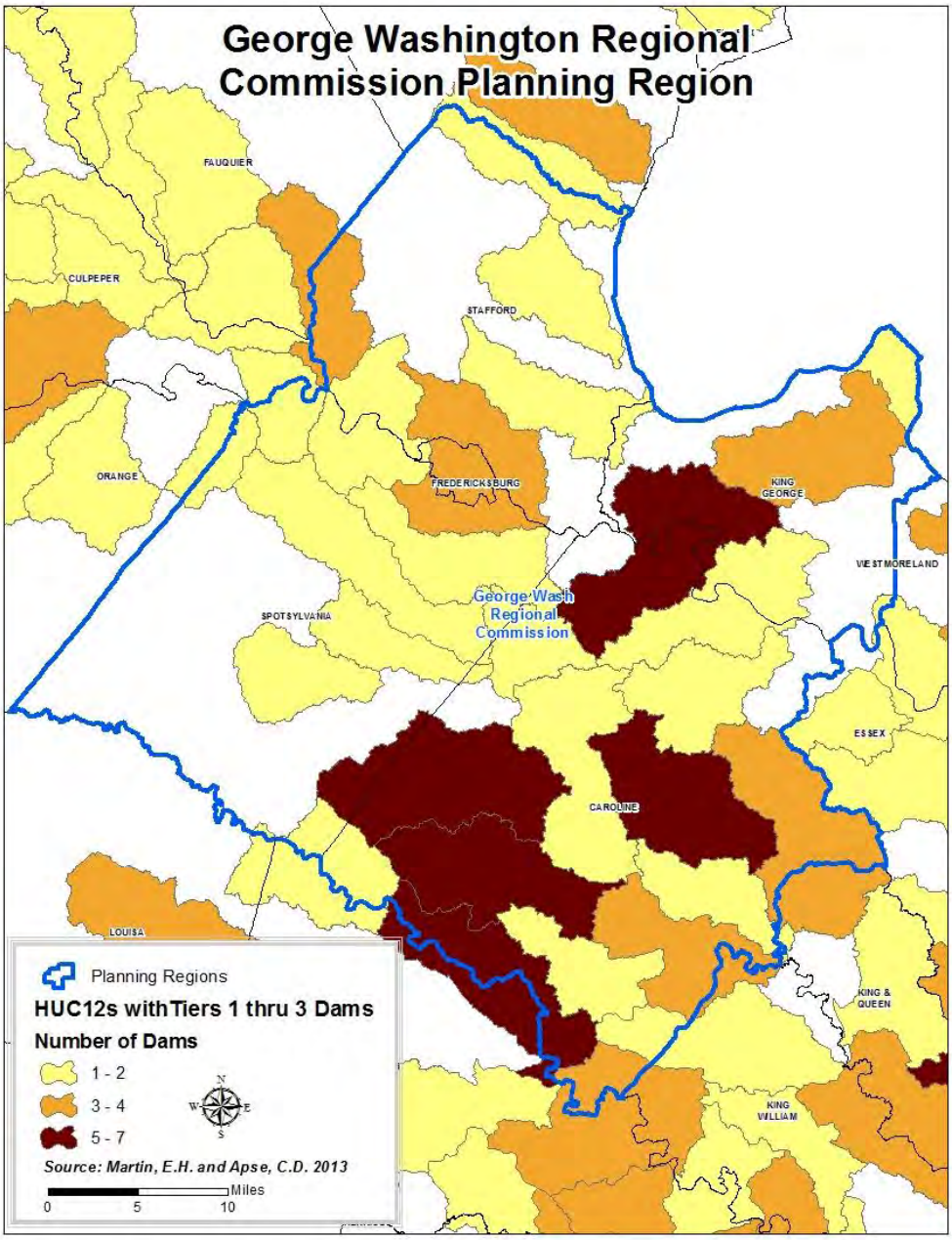

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the George Washington Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt land use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitat

Mixed hardwood and conifer forests make up over half of George Washington Planning Region (approximately 494,035 acres or 54 percent of the planning region) and are important for a broad range of species (Anderson et al. 2013). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitats for a variety of priority SGCN species, including the common rainbow snake, Eastern whip-poor-will, Kentucky warbler, yellow-billed cuckoo, among others.

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within George Washington Planning Region is fragmentation, which is mainly due to expanding development out of the Washington D.C. metropolitan area and resulting roads and infrastructure. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species, such as privet and Japanese stilt grass, and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

4. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates deer populations in Stafford and King George Counties need to be reduced in order to meet a variety of social and ecological goals (DGIF 2015). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. Deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive plants are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in the George Washington Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Upper York River Basin Watershed Implementation Plan* developed for DEQ specifically highlights reforesting areas around eroding crop lands and pastures within the Plentiful Creek watershed to help decrease sediment run off as well as provide wildlife habitat (Blue Ridge Environmental Solutions 2011).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction, such as portions of Stafford County. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times within Virginia's current Deer Management Plan and will be similarly addressed in the revised 2015-2024 Deer Management Plan (DGIF 2015). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the George Washington Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers may want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 32,000 acres (2.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than three percent), these habitats are important for priority SGCN, including the tawny crescent and Persius duskywing butterfly.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015b). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2008). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2008). The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more prone to drought. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2013). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2013). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the George Washington Planning Region, priority conservation opportunities include:

- Protecting and restoring tidal and non-tidal wetlands; Improving the quality;
- Conserving water quantity in creeks and rivers through best management practices and implementing water quality improvement mechanisms; and
- Conserving tracts of mature hardwood forests and mature pine forest.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN GEORGE WASHINGTON PLANNING REGION

Complete SGCN list for the George Washington Planning Region (SGCN=76). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Brant	*Branta bernicla*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird	**SE**	I	a	Black rail	*Laterallus jamaicensis*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*

Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*

Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

11. HAMPTON ROADS PLANNING REGION LOCAL ACTION PLAN SUMMARY

WILDLIFE ACTION PLAN AND LOCAL SUMMARIES OVERVIEW

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that*

manage significant land and water areas within the state or administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Recreation Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing

resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

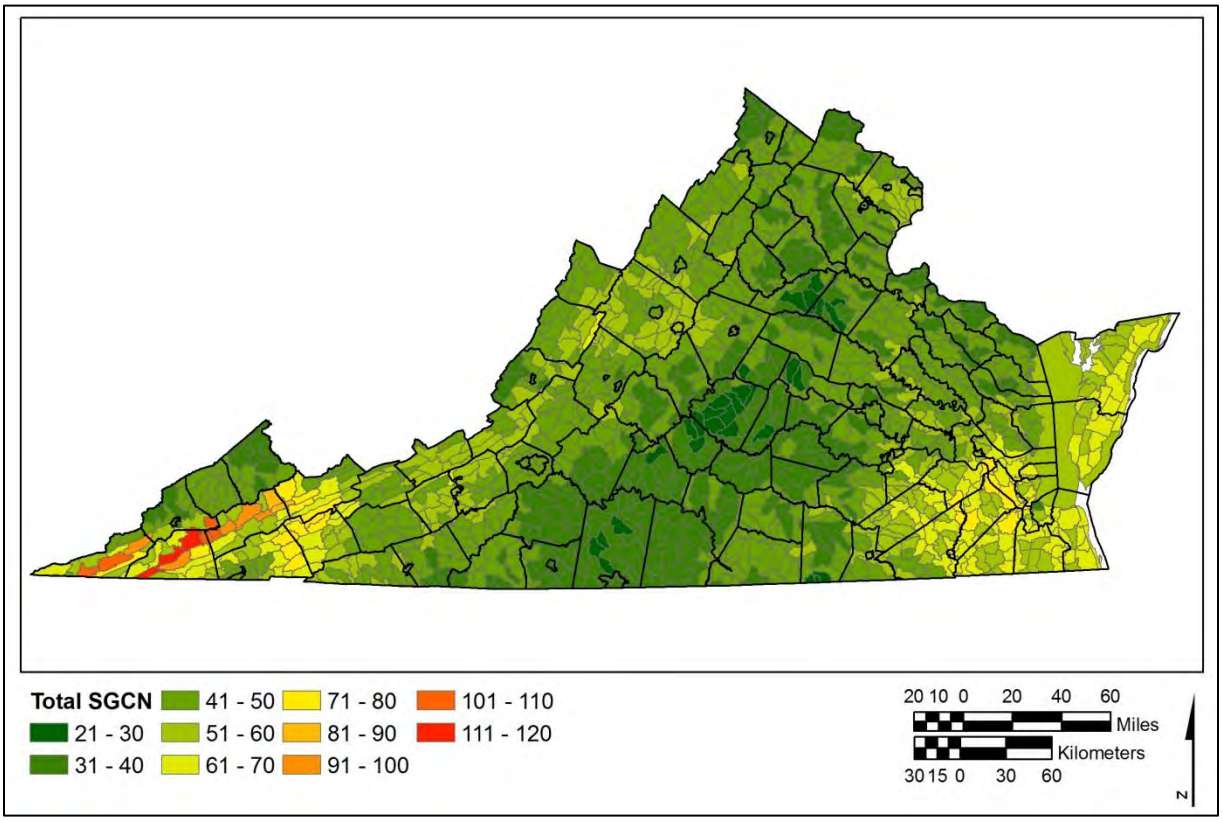

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions (DCR 2013). Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

HAMPTON ROADS PLANNING REGION SUMMARY OVERVIEW

The Hampton Roads Planning Region consists of 2,394,400 acres (3,741 square miles) and includes the following counties Isle of Wight County, James City, Southampton County, and York as well as the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg. The human population in this planning region is estimated to be 1.57 million people (U.S. Census Bureau 2015). All counties and cities (except Norfolk) are projected to experience population growth by 2030 (VIMS 2013).

Despite the pressures of a more urban environment, this planning region provides habitats for a diversity of SGCN. This planning region is especially important to the conservation of red cockaded woodpecker found within pine savanna habitat. This savanna habitat is also important to Bachman's sparrow, oak toad, and eastern glass lizard, among other species. The region's blackwater systems support a broad range of SGCN such as the blackbanded sunfish, swampfish, and dwarf waterdog. Mature pine forest habitat supports the southeastern fox squirrel. Additionally, the phreatic isopod (*Caecidotea phreatica*) and funnel-web spider likely only occur within this planning region and nowhere else in the world. Hampton Roads Planning Region also includes a variety of other habitat types such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, and tidally influenced streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

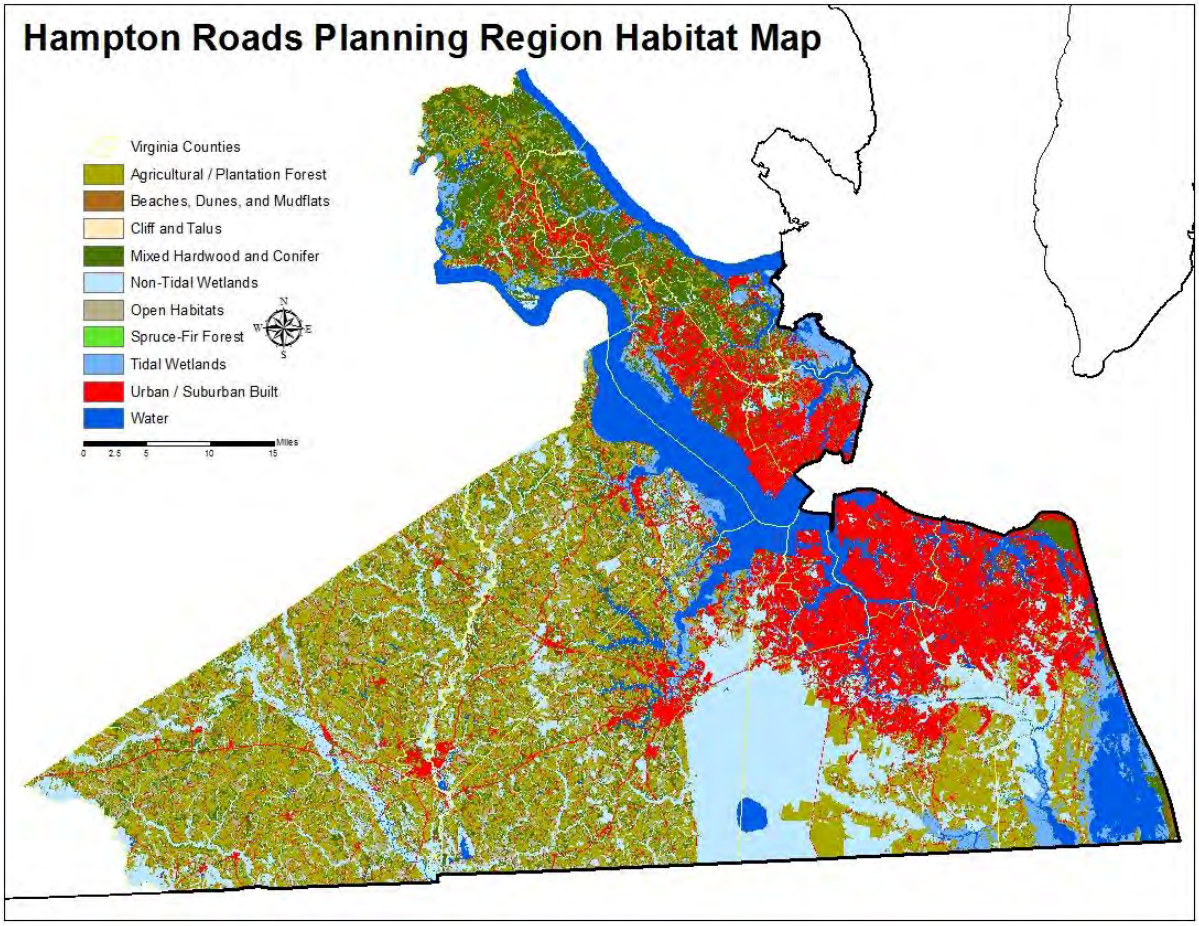

Figure 2. Hampton Roads Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 139 are believed to either occur, or have recently occurred, within the Hampton Roads Planning Region (Appendix A). Of these 139 species, ***120 SGCN are dependent upon habitats provided within the Hampton Roads Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 120 priority species within this planning region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in

three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	14
Ib	5
Ic	1
IIa	11
IIb	3
IIc	1
IIIa	12
IIIb	5
IIIc	6
IVa	32
IVb	13
IVc	17

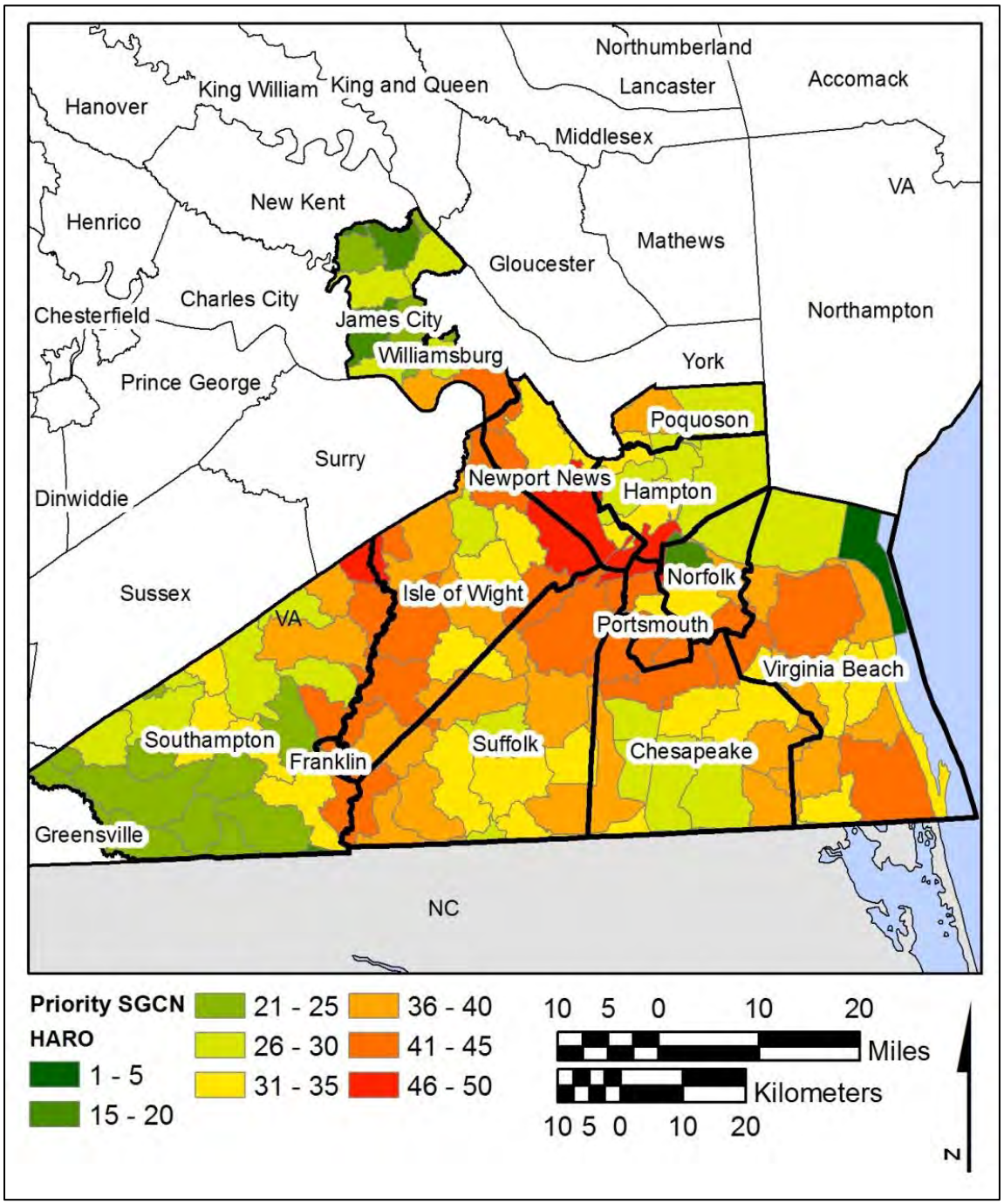

Figure 3. Priority SGCN Density in the Hampton Roads Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within Hampton Roads Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian	**ST**	II	a	Barking treefrog	*Hyla gratiosa*	Forests near or within shallow wetlands
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*	Freshwater wetlands with sphagnum moss
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*	Freshwater wetlands with sphagnum moss
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*	Forest and upland habitat generalist but require soils suitable for digging
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*	Site specific pine savanna
Amphibian		IV	a	Greater siren	*Siren lacertina*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*	Most abundant in wetlands within pine savanna habitats
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*	Pine and hardwood forests with vernal ponds and other water sources suitable for breeding
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*	Gum and cypress swamps as well as other wooded wetlands
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*	Pine savanna
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*	Grassy wet areas within or near pine forests
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water.. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*	Migratory with weak habitat associations in Virginia
Bird		II	a	Black skimmer	*Rynchops niger*	Beach species that nests on bare sand

Bird	IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird	IV	a	Black-bellied plover	*Pluvialis squatarola*	Winter resident along beaches and estuaries
Bird	III	a	Black-crowned night-heron	*Nycticorax nycticorax hoacti*	Variety of marshes, swamps, and wooded streams
Bird	III	a	Brant	*Branta bernicla*	Saltmarshes and estuaries
Bird	IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird	IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird	IV	b	Clapper rail	*Rallus longirostris*	Saltmarshes
Bird	II	a	Common tern	*Sterna hirundo*	Nests primarily on open dynamic beaches
Bird	IV	a	Dunlin	*Calidris alpina hudsonia*	Winter resident shorelines and estuaries
Bird	IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird	IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird	IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird	III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird	IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird	IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird	III	a	Forster's tern	*Sterna forsteri*	Nests in marine and estuarine marshes
Bird	I	a	Glossy ibis	*Plegadis falcinellus*	Wooded wetlands, estuarine marshes and waters and saltmarshes

Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	a	Greater scaup	*Aythya marila*	Winter resident on tidal rivers
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird	**ST**	I	a	Gull-billed tern	*Gelochelidon nilotica*	Nests on open sandy beaches and marsh shell rakes
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird		II	b	King rail	*Rallus elegans*	Variety of fresh water and marine marshes and wetlands
Bird		IV	a	Laughing Gull	*Leucophaeus atricilla*	Seacoasts, bays, estuaries, rarely on large inland bodies of water
Bird		III	b	Least bittern	*Ixobrychus exilis exilis*	Freshwater marshes
Bird		III	a	Least tern	*Sternula antillarum*	Nest on open beaches
Bird		II	a	Little blue heron	*Egretta caerulea*	Freshwater and brackish marshes
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	a	Marbled godwit	*Limosa fedoa*	Occur regularly in the seaside lagoon system throughout the winter
Bird		IV	b	Marsh wren	*Cistothorus palustris*	Freshwater marshes with cattails and reeds
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*	Wintertime resident of maritime wetlands
Bird		III	a	Northern Bobwhite	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	a	Northern Gannet	*Morus bassanus*	Coastal waters primarily but sometimes several hundred miles out to sea
Bird		IV	a	Northern Pintail	*Anas acuta*	Lakes, rivers, marshes and ponds in grasslands or cultivated fields
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Bird	**FTST**	III	a	Piping plover	*Charadrius melodus*	Beaches and sand pits
Bird		IV	c	Purple sandpiper	*Calidris maritima*	Winter resident along beaches and jetties

Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*	Migrant along barrier islands and to a lesser extent in the Chesapeake Bay
Bird	**FESE**	I	a	Red-cockaded woodpecker	*Picoides borealis*	Pine savanna
Bird		IV	a	Royal tern	*Thalasseus maxima*	Sandy beaches
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	a	Sanderling	*Calidris alba*	Primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers also on exposed reefs.
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*	Grassy salt marshes
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*	Migrant, migration habitat includes saltwater tidal flats, beaches, and salt marshes
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*	Forested moist lower slopes with a rhododendron shrub layer
Bird		IV	b	Virginia rail	*Rallus limicola*	Fresh and brackish marshes, may visit salt marsh in winter
Bird		I	b	Wayne’s black-throated green warbler	*Setophaga virens waynei*	Cypress and white cedar swamps
Bird		IV	a	Whimbrel	*Numenius phaeopus*	Coastal migrant that typically occurs in a variety of saltmarsh habitats
Bird	**SE**	I	a	Wilson's plover	*Charadrius wilsonia*	Beaches and tidal mud flats often on barrier islands
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*	Sluggish streams and swamps with abundance of dead wood on the bottom
Crustacean	**FS**	I	c	Phreatic isopod	*Caecidotea phreatica*	Shallow subterranean groundwater habitats
Fish		IV	a	Alewife	*Alosa pseudoharengus*	Migratory
Fish		III	a	American eel	*Anguilla rostrata*	Migratory uses variety of freshwater and marine habitats

Fish		IV	a	American shad	*Alosa sapidissima*	Large unfragmented migratory rivers for spawning
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory and utilize variety of aquatic and marine habitats
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*	Blackwater swamps, ponds, and streams with thick vegetation
Fish	**SE**	I	a	Blackbanded sunfish	*Enneacanthus chaetodon*	Acidic pools, creeks, and swamps with thick vegetation
Fish		I	a	Bridle shiner	*Notropis bifrenatus*	Slow clear water with aquatic vegetation
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*	Moderately acidic creeks, streams, and swamps
Fish		IV	c	Lake chubsucker	*Erimyzon sucetta*	Clear to slightly stained warm water ponds, lakes, ditches, and streams
Fish		IV	c	Lined topminnow	*Fundulus lineolatus*	Moderately acidic margins of swamps and creeks with dense vegetation
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*	Swamps, ponds, and slow moving water
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*	Small streams to rivers with swift flow and sandy substrates
FW Mollusk		III	c	Dwarf waterdog	*Necturus punctatus*	Sluggish streams and blackwater streams with debris
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*	Areas of limited currents and significant amounts of fine organic matter. Can tolerate a wide range of substrates
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*	Clean water with slow currents and sandy substrates, most often found in rivers with stable shorelines and wide riparian forests.
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*	Deeper channels of relatively fast flowing rivers
FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*	No specific habitats have been identified for this aquatic snail but it occurs across most of North America
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*	Ponds, canals, and slow moving sections of rivers, often connected to the ocean. Can tolerate a wide variety of substrates
Insect	**FE**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	Beach obligate - does not tolerate heavy foot or vehicle traffic

Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*	Riparian forests
Mammal	FE	IV	b	Fin whale	*Balaenoptera physalus*	Marine
Mammal		IV	c	Harbor porpoise	*Phocoena phocoena*	Marine
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*	Freshwater wetlands
Mammal	FT	I	a	Northern Long-Eared bat	*Myotis septentrionalis*	Hibernate in caves and mines. Mature forests for summer roosts and feeding.
Mammal	FE	I	b	Northern right whale	*Eubalaena glacialis*	Marine
Mammal		III	b	Pungo white-footed mouse	*Peromyscus leucopus easti*	Coastal marshes and dunes
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*	Use hollow trees as well as various types of human structures for roosting
Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*	Open mature stands of pine or pine/hardwoods
Mammal		IV	b	Southeastern myotis	*Myotis austroriparius*	Riparian forests with suitable roost structures
Mammal	FE	IV	b	West Indian manatee	*Trichechus manatus latirostris*	Marine
Other Terrestrial Invertebrate	**FS**	II	c	A funnel-web spider	*Barronopsis jeffersi*	No habitats have been identified for this species
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*	Barren
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*	Permanent ponds, marshes, streams, and rivers, east of the Shenandoah river, with vegetated shorelines and amphibian and small fish populations.
Reptile	**SE**	I	b	Eastern chicken turtle	*Deirochelys reticularia reticularia*	Extreme habitat specialist - only two sites known
Reptile	**ST**	II	a	Eastern glass lizard	*Ophisaurus ventralis*	Pine savanna
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	Upland pine habitats
Reptile		III	c	Glossy crayfish snake	*Regina rigida rigida*	Freshwater wetland generalist
Reptile		I	b	Green sea turtle	*Chelonia mydas*	Marine
Reptile		I	a	Kemp's ridley sea turtle	*Lepidochelys kempii*	Marine
Reptile		I	a	Leatherback Sea Turtle	*Dermochelys coriacea*	Marine

Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*	Nests on ocean-facing beaches and occurs in the lower Chesapeake Bay and inshore, nearshore and offshore coastal waters
Reptile		IV	c	Mudsnake	*Farancia abacura abacura*	Wetland generalist as long as aquatic salamanders are present
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*	Beach nester and salt marsh
Reptile		IV	c	Rainbow snake	*Farancia erytrogramma erytrogramma*	Riparian forest - eel obligate
Reptile		IV	c	Scarletsnake	*Cemophora coccinea copei*	Forest generalist but require soils suitable for digging
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*	Forest generalist but require soils suitable for digging
Reptile	**CC**	III	c	Spotted turtle	*Clemmys guttata*	Freshwater swamps and marshes
Reptile		IV	c	Yellow-bellied slider	*Trachemys scripta scripta*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands within Hampton Roads Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks to state wildlife management areas, and National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Back Bay National Wildlife Refuge,
- Dismal Swamp National Wildlife Refuge,
- Princess Anne Wildlife Management Area,
- Plum Tree Island National Wildlife Refuge,
- Cavalier Wildlife Management Area,
- False Cape State Park,
- Colonial National Historical Park,
- First Landing State Park and Grandview Beach Nature Preserve; and
- Hog Island State Waterfowl Refuge.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities. Multiple military installations such as Naval Station Norfolk and others have valuable habitat resources, and conservation efforts taken on those lands contribute to species and habitat protection within the planning region.

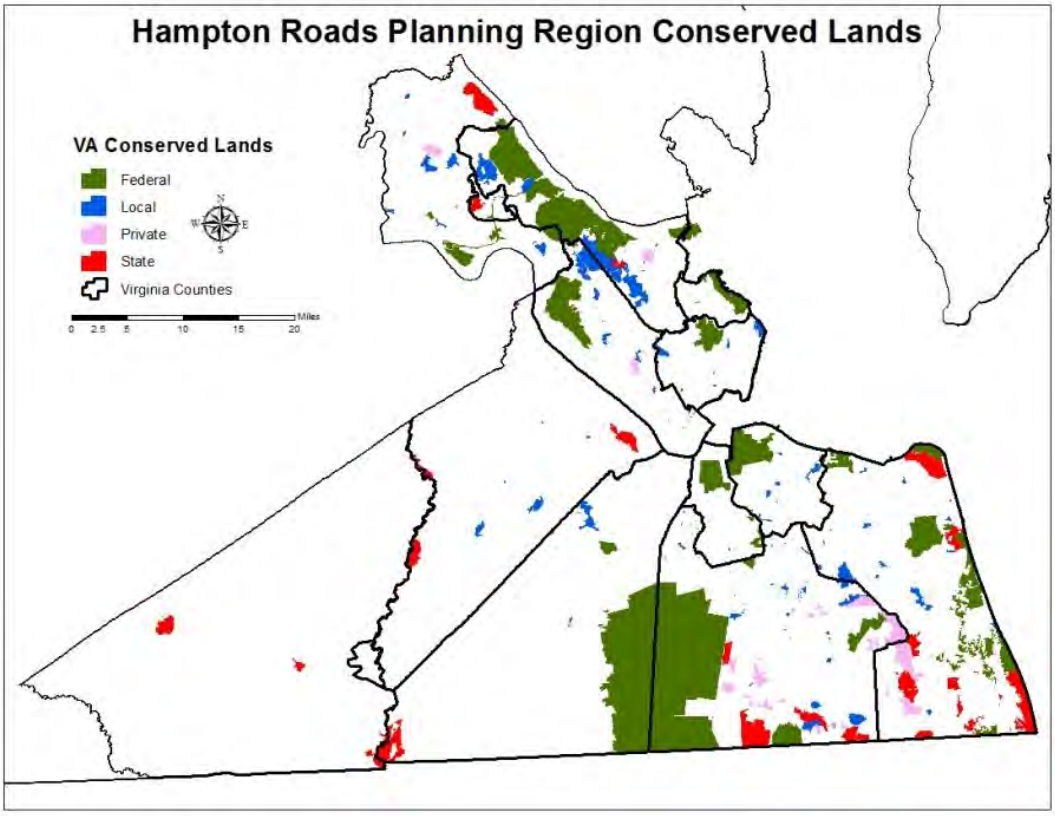

Figure 2. Conservation Lands in the Hampton Roads Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts within Hampton Roads Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered. For example, in 2011 Back Bay National Wildlife Refuge provided over $4 million in economic benefit to the local economy which was realized through visitation expenditures, employment, and tax revenues (Carver and Caudill 2013). To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Hampton Roads Planning Region

Few places in Virginia are expected to be as affected by climate change as much as the Hampton Roads Planning Region. A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013).

Tropical storm events are expected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are expected to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013). Based on climate projections, the counties in the planning region are projected to have at least 600 miles of roads flooded due to storms and sea-level rise (VIMS 2013). Additionally, at least 130 square miles of land is vulnerable to sea-level rise impacts within this planning region (VIMS 2013; Titus, 2010). The Sea-Level Affecting Marshes Model was run for Plum Island National Wildlife Refuge and projects at 0.4 meters of sea-level rise (or approximately 1.3 feet), the majority of the refuge's salt marsh, brackish marsh, and estuarine beach would be lost (Pinnacle and 2009).

Increases and changes in temperature and precipitation will also negatively affect habitats and SCGN in the Hampton Roads Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson, 2011; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke, et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in Hampton Roads Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Hampton Roads Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for Hampton Roads Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and conserve beach, dune, and mudflat habitats	1) Balance conservation, human, and economic uses for beach, dune, and mudflat habitats; 2) Research climate change impact on beaches; 3) Focus acquisition on areas inland of existing beaches to help protect them and potentially provide migration corridors; and 4) Control invasive species.	Land conversion, climate change, non-native and exotic invasive species, predators	Enhanced ecotourism opportunities	Areas inland of already protected beaches
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Promote living shorelines where feasible and minimize hardened shorelines; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, water supply, climate change, invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish riparian vegetative buffers along waterways; 2) Continue to implement programs that prevent erosion and limit the flow of sediment into streams; 3) Establish waste storage facilities; 4) Establish retention ponds, impoundments, or other features to manage and slow urban storm water runoff; 5) Work with landowners to implement small acreage grazing systems; 6) Continue improving storm water management systems; 7) Improve sewer facilities for the boating public; 8) Repair or replacing failing septic systems and pit privies; 9) Work to prevent pet and kennel waste from entering waterways; 10) Continue supporting DGIF deer control programs; 11) Continue to identify impaired waters within the planning region; 12) Restore aquatic connections; 13) Monitor and address invasive species impacts; and 14) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, ship strikes and overfishing, climate change, non-native and exotic invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; Sustain sport fisheries and recreation opportunities; contribute to clean water supply	Darden Mill Run, Elizabeth River Eastern Branch, Hoffler Creek, Lynnhaven Bay, Broad Bay, Linkhorn Bay, Mill Creek, Mill Swamp, Milldam Creek, Nanney Creek, Powhatan Creek, Racoon Creek, Rattlesnake Creek, Three Creek, Upper Nansemond River, West Neck Creek Watersheds adjacent to Back Bay NWR
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4)	Land use change and conversion, invasive species, climate change, threats to maritime forests	Flood control; water quality; and ecotourism/ wildlife viewing/ upland hunting	Forest patches adjacent to already protected parcels and pine savannas

	Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.			
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers	Open habitats that support SGCN
Collaborate with landowners to maintain and manage developed habitats	1) Conduct intensive monitoring and management to ensure impacts to birds are minimized at these heavily disturbed sites; 2) Encourage municipalities that own and manage public beach beaches to take measures to minimize the degree of human disturbance to SGCN utilizing these sites during the breeding season and other times of the year when appropriate (e.g., posting signs or establishing seasonal closures to keep the public out of sensitive areas, enacting and enforcing leash laws or a no pets policy, etc.).	Disturbance, alteration, or destruction to habitat by human activities	Conservation of important bird species	Sensitive developed habitats

Maintain and Conserve Beach, Mudflat, and Dune Habitat

The Hampton Roads Planning Region has extensive beach habitat that benefit many Action Plan species. Mudflats provide important foraging areas for red knots, purple sandpiper, and other species. Beaches and dunes are important nesting habitats for diamond backed terrapins, loggerhead turtles, pungo white-footed mouse, least terns, and numerous other migratory birds. Dunes also protect inland habitats, such as the relatively rare maritime forest communities from the more intense storm surges and salt spray. Beach, dune, and mud flat habitat make up approximately 2,955 acres (0.17 percent) of the planning region (Anderson et al. 2013).

Threats

Although some of the planning region's beach, dune, and mudflat habitats are protected by state and federal agencies, significant threats still exist.

1. Habitat Conversion/ Alteration: Beach, dune, and mudflat habitat in this planning region is significantly threatened by human population growth and expansion from city centers. The accompanying development and infrastructure being built up against the dunes and beaches can destroy or alter fragile habitats. Shoreline hardening is also an issue along the beach front as well as along the Chesapeake Bay area. Hardening prevents natural processes from occurring and can result in erosion, displacement of sediment, and loss of shoreline habitat.

2. Climate Change: Climate change, with resulting sea-level rise and more intense storm events, will likely lead to increased coastal flooding, presenting a significant challenge for the barrier islands and low lying areas on the peninsula. The effects of flooding are further exacerbated by naturally occurring land subsidence. Severe storms as well as sea-level rise will also likely increase erosion and salt water intrusion along the coast into sensitive ecosystems.

3. Invasive Species: Invasive species such as *Phragmites* and beach vitex (*Vitex rotundifolia*) often out-compete native vegetation and reduce the value of local habitats.

Conservation Management Actions

Beaches, dunes, and mudflats are dynamic and have important habitat and economic value. Conservation actions will require the conservation community to work closely with agencies, landowners, municipalities, and elected officials to find a sustainable balance between conservation, human recreation, and economic development. Each of these entities has valid regional concerns that should be considered within the broader management context to accommodate the various interests.

Many important beach, dune, and mudflat habitats for SGCNs have been protected within this planning region. However, there are beaches that would enhance conservation of SGCN and other important species and could be considered for protection through easements, acquisition or partnerships. Climate projections indicate many current beaches could be inundated by a combination of sea-level rise and land subsidence. Under such circumstances, acquiring these areas might not be a wise investment of limited conservation resources. Continuing to monitor and control invasive plant species will help enhance growth of native vegetation and maintain healthy habitats.

Climate-Smart Management Actions

As the climate changes and sea levels rise and land continues to naturally subside, the dynamic beaches, dunes, and mudflats are likely to move and migrate. Over time, this could bring these habitats, and the species that rely upon them, into conflict with existing land uses. Research is needed to understand how these systems are likely to change and to identify opportunities to work with willing landowners to acquire buffer properties that would facilitate movement. Until this issue is better understood, working with willing landowners to acquire properties inland and adjacent to existing conserved beaches may be a useful strategy to provide the opportunity for these habitats to migrate under changing climatic conditions. Protecting these areas can occur through acquisition or partnerships with landowners. Expanding monitoring along these areas to enable early detection and action as areas become increasingly affected by sea-level rise and storm events (Glick et al. 2008).

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Hampton Roads Planning Region. In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes are the most common wetland type in this area and are important habitat for the marsh rabbit, eastern lesser siren, carpenter frog, eastern mudsnake and spotted turtle. Tidal marshes are home to marbled godwit, snowy egret, seaside sparrow, a variety of rails and many other species.

Table 4. Wetland Acreage in Hampton Roads Planning Region (Anderson et al. 2013; DGIF 2014).

Wetland Type	Acreage	Percent of Planning Region
Non-Tidal Wetland	360,913.77	20.87%
Tidal Wetland	65,375.08	3.78%

Threats

The health and quality of non-tidal and tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the region.

2. Land Use Changes: Hampton Roads Planning Region has extensive wetland areas; many are under protection on state or federal lands, or private lands. One of the most significant threats to wetlands

outside these protected areas is conversion to other uses and hardening of shorelines that can harm wetland integrity and prevent inland migrations as sea levels rise. As more areas are developed for additional human uses wetland areas will likely be lost.

3. Water Supply: As human populations grow and infrastructure is built to support this growth, water supplies will likely be taxed, which can affect wetland hydrology and health of the system.

4. Invasive Species: Invasive species often degrade the quality of wetland habitat through damage or loss to wetland vegetation. Nutria eat large amounts of aquatic vegetation and destroy wetlands by burrowing into the substrate. Mute swans out-compete native species by consuming significant amounts of emergent and submerged aquatic vegetation (DGIF 2012). Mute swans can also destroy vegetation by uprooting it, thereby limiting the effectiveness of wetland restoration (DGIF 2012). Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites,* purple loosestrife, nutria, mute swans, and exotic invertebrates.

5. Climate Change: As sea levels rise and land subsides, marshes can be inundated and converted to shallow open water habitats. Shallow open water habitats will not likely support the same vegetative composition as wetlands, affecting the wildlife species that depended on tidal wetland habitats (CCSP 2009). Additionally, as storms become more intense, increased wave action and scouring may lead to significant erosion and loss of these coastal wetlands. Increased salinity levels from sea-level rise and more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Hampton Roads Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate inland as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Although a significant portion of wetlands is conserved, the protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Hampton Roads Planning Region include those wetlands that are inland of tidal wetlands that may provide some opportunity for inland migration as sea levels rise. These more inland areas also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). A portion of high priority wetlands for conservation are adjacent to already protected areas providing an opportunity to expand upon those areas in James City, Suffolk and Virginia Beach. Outstanding areas for restoration occur throughout the planning region.

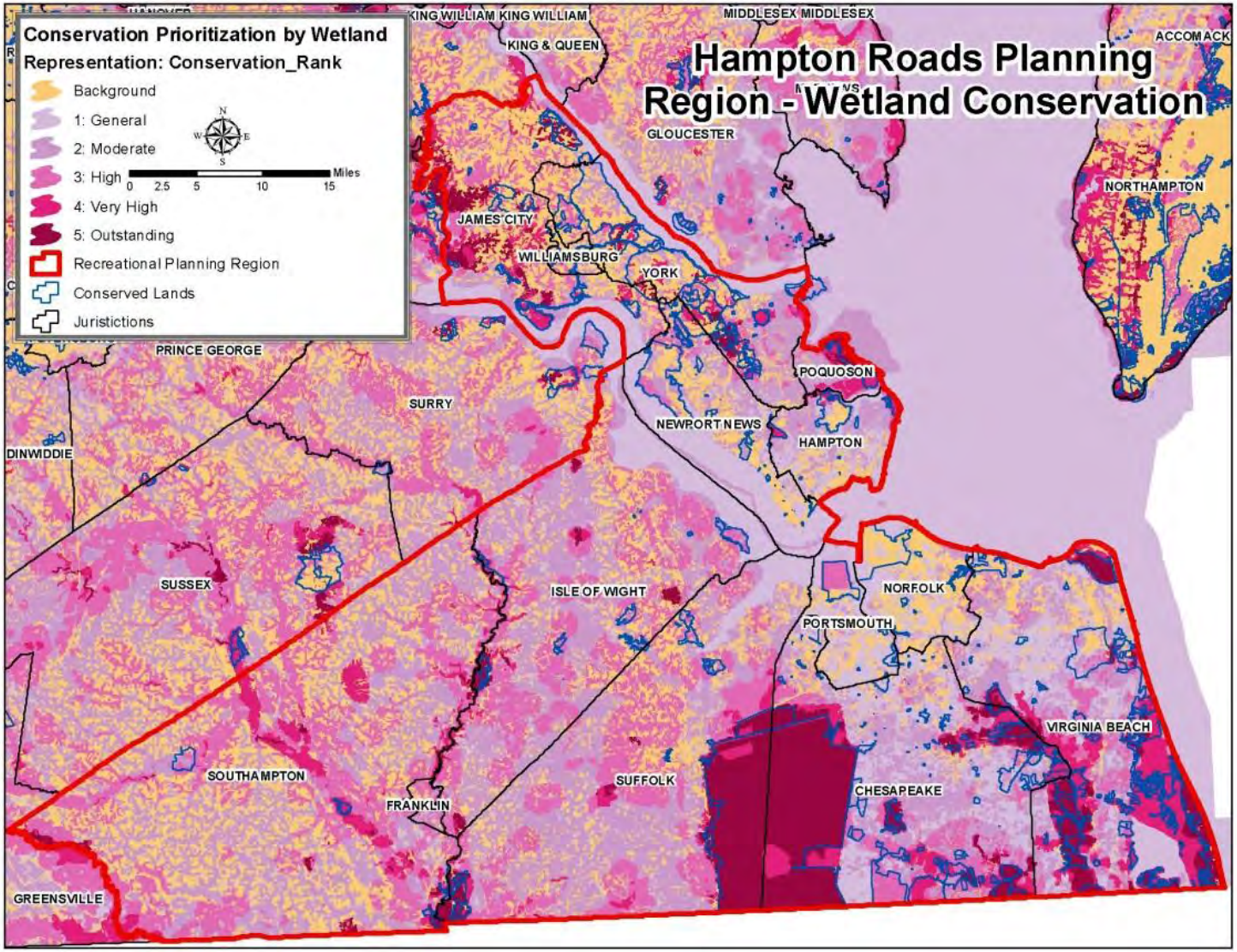

Figure 5. Wetland Conservation Priority Areas in Hampton Roads Planning Region (Weber and Bulluck 2014).

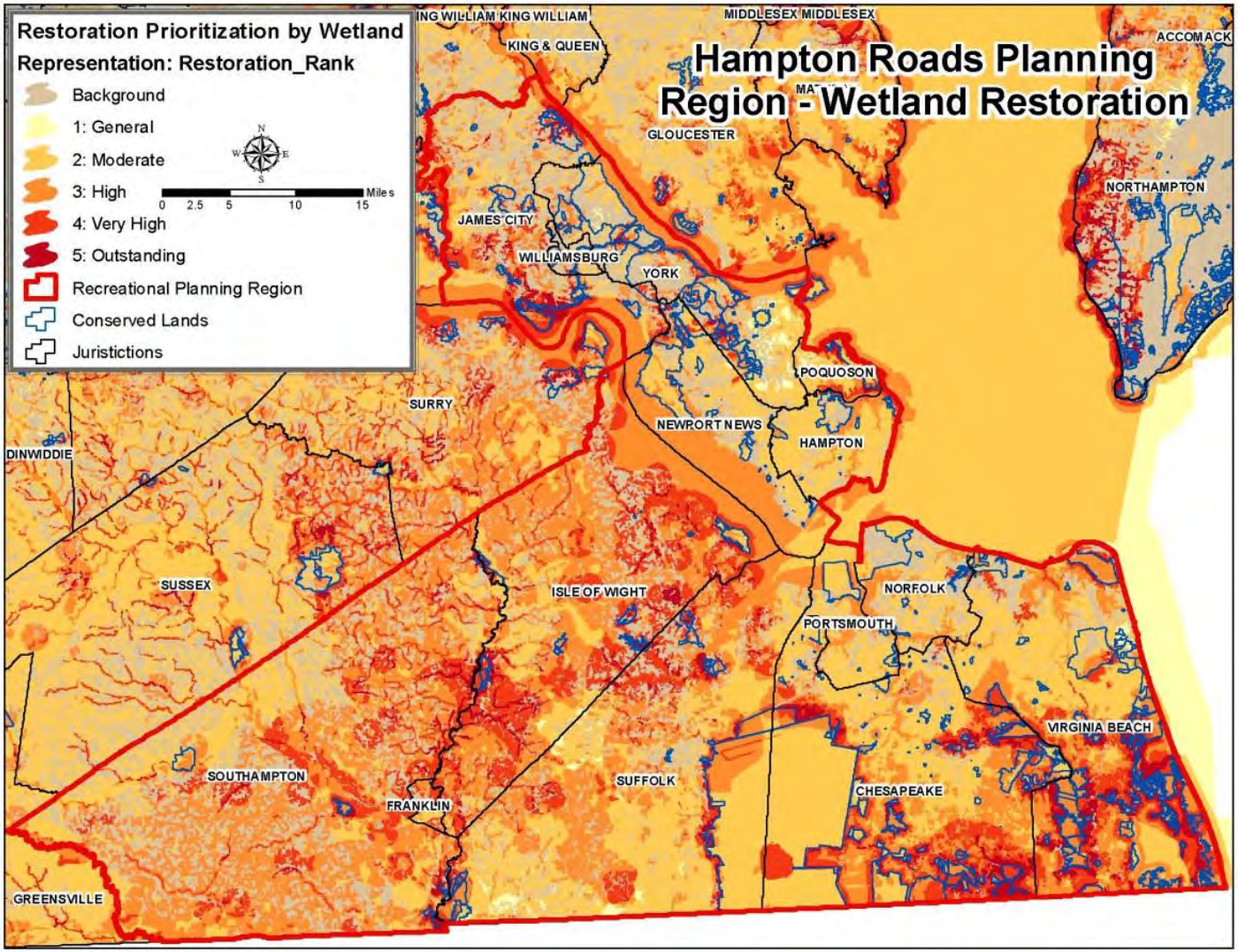

Figure 6. Wetlands Restoration Priority Areas in the Hampton Roads Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Hampton Roads Planning Region include tidal and non-tidal rivers and streams as well as the lower Chesapeake Bay. Larger river systems include the James and York Rivers. Blackwater systems are a unique habitat type within Virginia and generally occur south of the James River. They consist of sandy soils with tannin stained waters and little suspended clay sediment. They often are associated with bald cypress and tupelo as well as other bottomland hardwoods, but they also may have small, shrubby sloughs and shrub and herb layers (Anderson et al. 2013). Approximately 204,000 acres (11.8 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these aquatic systems within this planning region include sharp sprite snail, lake chubsucker, blackbanded sunfish, swampfish, Atlantic sturgeon, American shad, alewife, and common rainbow snake.

Threats

Aquatic and riparian habitats within the Hampton Roads Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Hampton Roads Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in

hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Much of the Hampton Roads Planning Region has a low percentage of impervious surface cover; however, the larger population centers have a higher percentage of impervious surfaces (Figure 7).

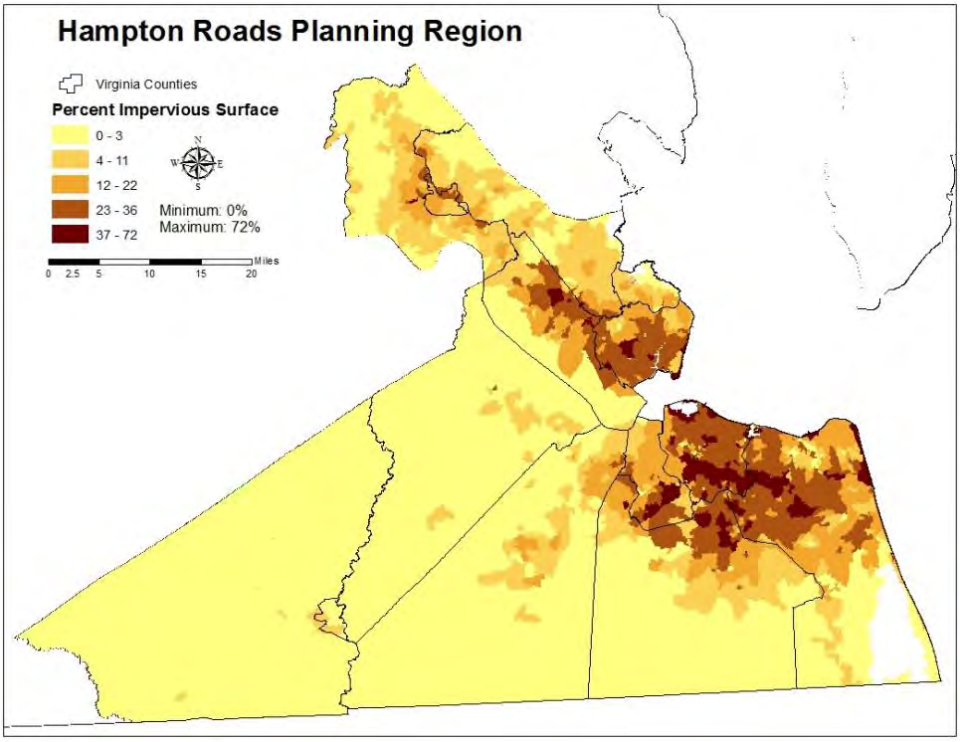

Figure 7. Impervious Surface Cover in Hampton Roads Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Hampton Roads Planning Region include invasive species such as blue catfish, flathead catfish, and Asian carp (e.g., big head carp and grass carp) that either consume native species or consume aquatic vegetation that alter the quality of aquatic habitats and invasive species that impair waterways. There is also the potential for new invasive species, such as the northern snakehead.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Climate change: Climate change will also affect aquatic systems in this planning region. Sea-level rise could result in inundation of shoreline, while changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

6. Channel dredging: Channel dredging will affect aquatic systems within the lower Chesapeake Bay by altering the aquatic landscape.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Darden Mill Run (Working Group 2013); Elizabeth River Eastern Branch; Hoffler Creek (Louis Berger 2012); Lynnhaven Bay, Broad Bay, and Linkhorn Bay (HRPDC 2006); Mill Creek (Tribo 2011); Mill Swamp (Working Group 2013); Milldam Creek (Tribo 2009); Nanney Creek (Tribo 2009); Powhatan Creek (Tribo 2011); Raccoon Creek (MapTech and New River-Highland 2005); Rattlesnake Creek (MapTech and New River-Highland 2005); Three Creek (Working Group 2013); Upper Nansemond River (Carlock and Tribo 2012); and West Neck Creek (Tribo 2009) (Figure 8).

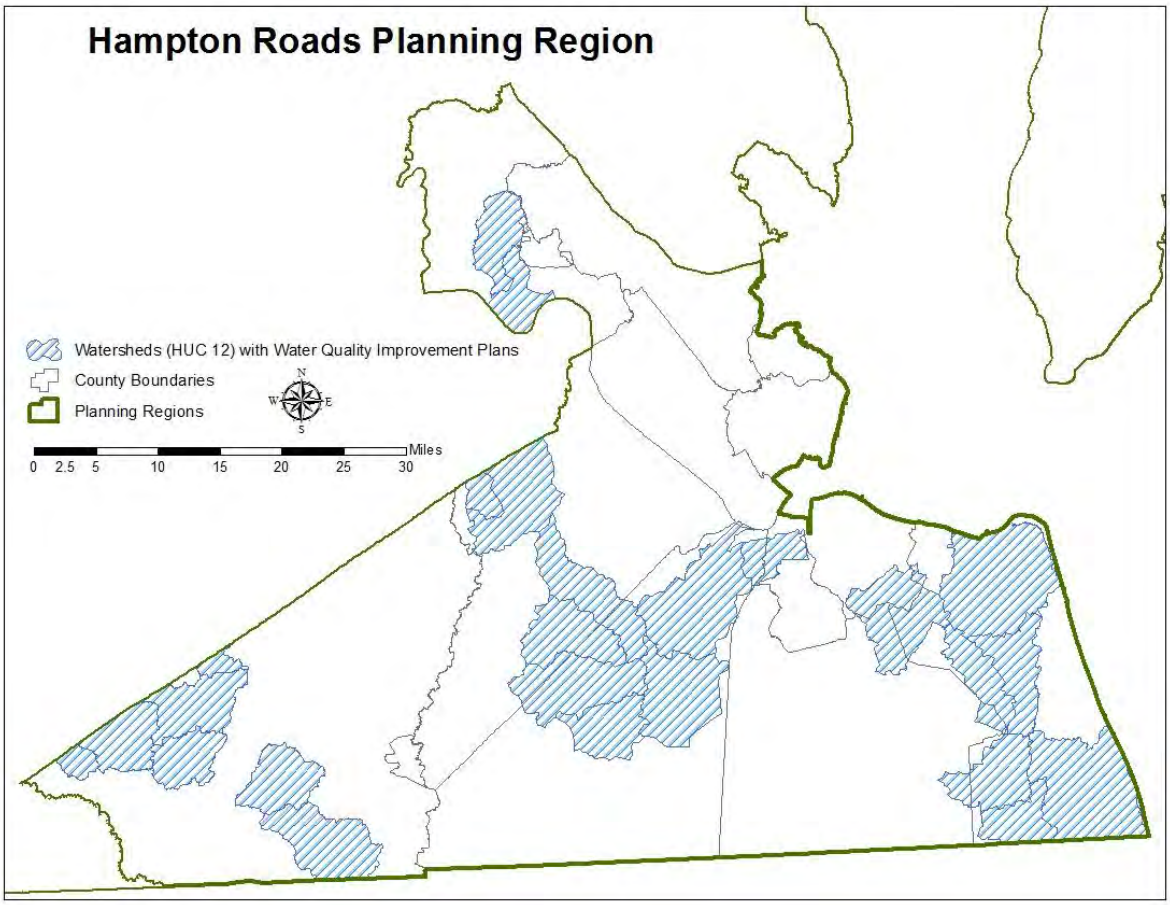

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality in these watersheds include:

- Establishing riparian vegetative buffers along waterways;
- Reforesting erodible pasture lands and establishing permanent vegetative cover on critical areas;
- Continue to implement programs that prevent erosion and limit the flow of sediment into streams;
- Establishing waste storage facilities (such as dairy lagoons or waste sheds) to better manage animal waste and prevent flow into the river;
- Establishing retention ponds, impoundments, or other features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands;
- Working with landowners to implement small acreage grazing systems;
- Continue improving storm water management systems;
- Improving sewer facilities for the boating public;
- Repairing or replacing failing septic systems and pit privies;
- Working to prevent pet and kennel waste from entering waterways and establishing a pet litter program to encourage owners to clean up pet waste; and
- Continue supporting DGIF deer control programs.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

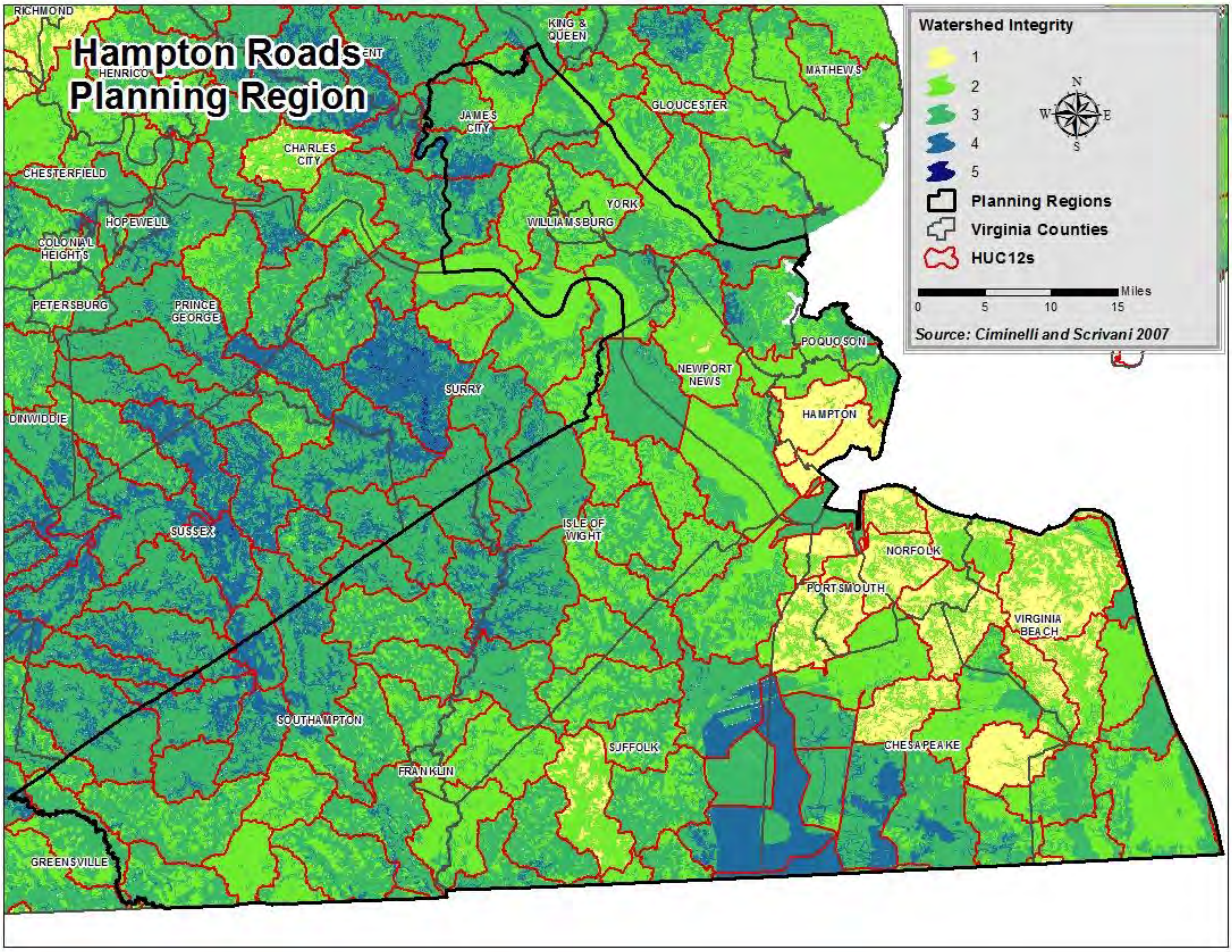

Figure 9. Watershed Integrity Model for Hampton Roads Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Hampton Roads Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other

opportunities, including the Environmental Quality Incentives Program. Back Bay NWR also focuses a portion of management on water quality and has implemented 100 foot buffers around open water areas and wetlands (USFWS 2010).

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

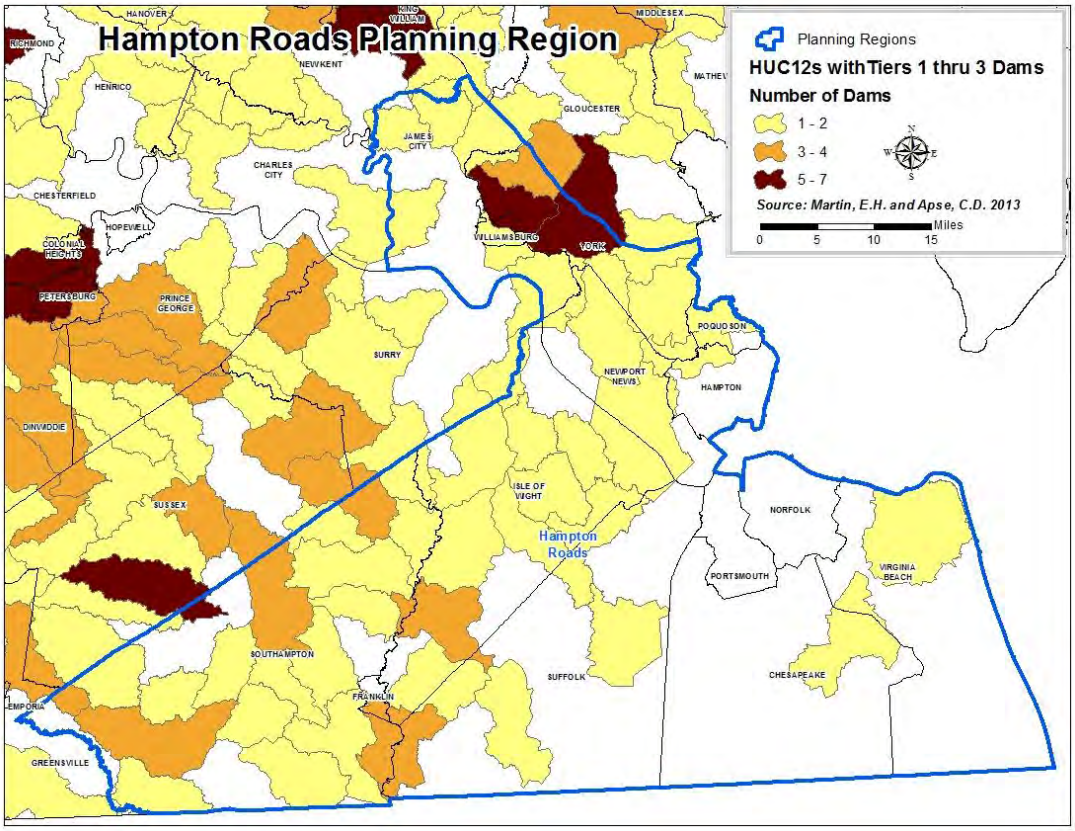

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Hampton Roads Planning Region include monitoring and addressing invasive species impacts as well as promoting efforts to rinse boats and trailers on site and working with the planning region to adopt practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Land acquisitions or easements that will help protect the land surrounding creeks should also be considered. For example, land acquisitions or easements that will help protect lands south and east of the Norfolk and Newport News areas should be considered to help protect against the impacts development will have on the planning region's aquatic systems.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Because sea-level rise will likely be an issue, native tree and shrub species that have a broader salinity tolerance should be considered.

Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of storm water runoff. Improving storm water control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwoods and conifer forests make up approximately 15 percent of the Hampton Roads Planning Region, and these habitats are important for a broad range of coastal species (Anderson et al. 2013) (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Hampton Roads Planning Region also retains some of the best examples of the rare coastal plain maritime forest which occur in small stands of stunted trees with contorted branches and dense vine layers that are often subject to salt spray, high winds, dune deposition, sand shifting, sand blasting, and occasional overwash (Anderson et al. 2013).

Table 5. Current forest acreage totals in Hampton Roads PDC (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	263,932.24	15.27%

Threats

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests in the Hampton Roads Planning Region is fragmentation, mainly due to development and resulting roads and infrastructure. In many cases with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the

mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Climate Change: Climate change also poses a significant threat to these forests. Sea-level rise and more intense storm events will not only inundate forested areas close to the coast, but also may result in significant salt spray and salt water intrusion into lower salinity areas. Climate change is also expected to affect precipitation regimes and result in warmer temperatures, potentially leading to more drought conditions that would be harmful to coastal forests.

3. Threats to Rare Maritime Forest Stands: Stands of maritime forests exist in the Hampton Roads Planning Region; however, they are rare. In 2007, the Virginia Institute of Marine Science (VIMS) completed a survey to delineate and determine the current distribution of maritime forests in Virginia (Berman and Berquist 2007). The review of satellite imagery and field surveys indicates that 2,705 acres or 100 percent of the maritime forest are conserved within this planning region. As the majority of this forest type exists on protected lands, there are no immediate threats to their persistence; however, during the coming decades, these rare forest stands will likely be threatened by climate change, including sea-level rise and the threat of increasing storm intensity and frequency (Berman and Berquist 2007). As beaches and dunes migrate, it is unclear what actions, if any, can be taken to facilitate the health and persistence of these rare forest patches.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in the Hampton Roads Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, remaining intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Water Quality Improvement Plan to Reduce Bacteria in Darden Mill Run, Mill Swamp, and Three Creek* developed for DEQ specifically highlights reforesting areas around eroding crop lands and pastures within the Darden Mill Run watershed to help decrease sediment run off as well as provide wildlife habitat (Working Group 2013).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of

invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (DOF 2014).

It will be extremely important to maintain the quality of habitats on lands that have already been conserved. Second, the conservation community may pursue opportunities to conserve other forest patches either through acquisition, easement, or agreement. Priority areas could include forest patches that buffer or expand conserved lands. Several agencies, including DGIF, DOF, USFWS, USFS, and NRCS also advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Climate-Smart Management Actions

To best manage forests in the Hampton Roads Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Sea-level rise and salt water intrusion and salt spray are expected to become more significant as sea levels rise and storms become more intense. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Harvest guidelines may need to be revised, depending on projections for future tree composition. Identifying and protecting inland areas where maritime forests may migrate inland will be an important step in working to conserve this rare forest type as sea levels rise and storms become more intense.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013). Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, glades, and barrens and make up approximately 69,327 acres (4 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change;

however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. Pine savannas also comprise a portion of the open habitats within this region.

Threats

Changing land use patterns has played a large role in the loss of open forests habitats as has the alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open forest species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, Chinese lespedeza, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

3. Pine Savannas: Threats to pine savannas include lack of opportunities for restoration due to limited acreage and proximity to population centers, limiting controlled burns, which are needed to maintain these forests.

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the red cockaded woodpecker, the northern bobwhite, field sparrows, eastern towhees, brown thrashers, prairie warblers, and monarch butterflies. The loss of these habitats has likely contributed to the declines in native pollinator species like bumblebees (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Southampton County offers some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are significant industries in Virginia and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities create a commercially viable forest plot that also benefits open habitat species such as quail. Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management (Puckett et al. 2008).

This planning region also contains some of the best examples of remaining long-leaf pine savanna in Virginia, which provide habitat for the red-cockaded woodpecker and southeastern fox squirrel. Almost all of these sites are owned and managed by government agencies or The Nature Conservancy. Although once a critical economic commodity for Virginia's maritime industries, the economic value of long-leaf pine has been overshadowed by the faster growing, and more commercially viable, loblolly pine. As such, few individual landowners have the economic ability to restore large areas of long-leaf pine on their properties to maintain savanna conditions. Opportunities to create new savanna habitats within this planning region will depend upon the conservation community acquiring properties with suitable soil conditions and managing these properties for savanna conditions. Properties near or adjacent to existing savannas should be considered a conservation priority.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Developed Habitats

Developed habitats include human created habitats that have been erected either on purpose or as a product of other activities. They range from dredge waste sites to industrial structures. Because of the loss natural coastal habitats, a number of beach-nesting seabirds (i.e., royal terns, gull-billed terns, black skimmers, least terns and common terns) are breeding on these human created habitats.

Threats

The primary threat to developed habitats is related to their location, generally close to urban areas and population centers. Human interaction and disturbance (e.g., noise, strikes, destruction of habitat) will negatively affect SGCN activities, ranging from nesting to breeding.

Conservation Management Actions

The Hampton Roads Bridge and Tunnel south island (owned and managed by the Virginia Department of Transportation) currently supports the largest seabird breeding colony in the state. Least terns nest at Craney Island Dredge Material Management Area (CIDMMA) in Portsmouth (owned and managed by the U.S. Army Corps of Engineers) and on one or two shopping mall rooftops every year. These locations require intensive monitoring and management on the part of the landowners, DGIF, and other partners to ensure impacts to birds are minimized at these heavily disturbed sites. These efforts should be continued and refined as conditions change. CIDMMA is another example. It provides year round habitat for numerous marsh dependent avian species. Thus, continuing to work with the U.S. Army Corps of Engineers to manage the site in a way that benefits birds and other SGCN is critical in this largely urban planning region. Additionally, it will be important to encourage municipalities that own and manage public beach beaches (e.g., Grandview Beach Nature Preserve owned by the City of Hampton) to take measures to minimize the degree of human disturbance to SGCN utilizing these sites during the breeding season and other times of the year when appropriate. Examples of such measures include, but are not limited to, posting signs or establishing seasonal closures to keep the public out of sensitive areas, enacting and enforcing leash laws or a "no pets" policy, and implementing predator control programs as needed. Finally, urban wading bird colonies have established in residential neighborhoods. Working with municipalities (e.g., Virginia Beach, Portsmouth, Norfolk) to develop and implement wading bird colony management plans that allow both human and avian residents to co-exist will be important.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species

	utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. In the Hampton Roads Planning Region, priority conservation opportunities include:

- Protecting beaches, dunes, and mud flats;
- Protecting and restoring tidal and non-tidal wetlands;
- Improving the quantity and quality of water in creeks and rivers through best management practices and water quality improvement mechanisms; and
- Conserving tracts of mature hardwood forests and pine savannas.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN HAMPTON ROADS PLANNING REGION

Complete SGCN list for the Hampton Roads Planning Region (SGCN=139). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian	**ST**	II	a	Barking treefrog	*Hyla gratiosa*
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*
Amphibian		III	a	Dwarf waterdog	*Necturus punctatus*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American oystercatcher	*Haematopus palliatus*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird		II	a	Black skimmer	*Rynchops niger*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		III	a	Brant	*Branta bernicla*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	b	Clapper rail	*Rallus longirostris*

Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird	**ST**	I	a	Gull-billed tern	*Sterna nilotica*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		II	b	King rail	*Rallus elegans*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Least tern	*Sterna antillarum*
Bird		II	a	Little blue heron	*Egretta caerulea*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		IV	a	Marbled godwit	*Limosa fedoa*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird	**FTST**	III	a	Piping plover	*Charadrius melodus*
Bird		IV	c	Purple sandpiper	*Calidris maritima*
Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*
Bird	**FESE**	I	a	Red-cockaded woodpecker	*Picoides borealis*
Bird		IV	a	Royal tern	*Sterna maxima*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		III	a	Saltmarsh sparrow	*Ammodramus caudacutus*
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*

Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		I	b	Wayne's black-throated green warbler	*Dendroica virens*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird	**SE**	I	a	Wilson's plover	*Charadrius wilsonia*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*
Crustacean	**FS**	I	c	Phreatic isopod	*Caecidotea phreatica*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*
Fish	**SE**	I	a	Blackbanded sunfish	*Enneacanthus chaetodon*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*
Fish		IV	c	Lake chubsucker	*Erimyzon sucetta*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Lined topminnow	*Fundulus lineolatus*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*

FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*
Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*
Mammal	FE	IV	b	Fin whale	*Balaenoptera physalus*
Mammal		IV	c	Harbor porpoise	*Phocoena phocoena*
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*
Mammal	FT	I	a	Northern Long-Eared bat	Myotis septentrionalis
Mammal	FE	I	b	Northern right whale	*Eubalaena glacialis*
Mammal		III	b	Pungo white-footed mouse	*Peromyscus leucopus easti*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*
Mammal		IV	b	Southeastern myotis	*Myotis austroriparius*
Mammal	FE	IV	b	West Indian manatee	*Trichechus manatus latirostris*
Other Terrestrial Invertebrate	**FS**	II	c	A funnel-web spider	*Barronopsis jeffersi*
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile	**SE**	I	a	Eastern chicken turtle	*Deirochelys reticularia reticularia*
Reptile	**ST**	II	a	Eastern glass lizard	*Ophisaurus ventralis*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		III	c	Glossy crayfish snake	*Regina rigida rigida*
Reptile		I	b	Green Sea Turtle	*Chelonia mydas*
Reptile		I	a	Kemp's ridley sea turtle	*Lepidochelys kempii*
Reptile		I	a	Leatherback Sea Turtle	*Dermochelys coriacea*
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*

Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

12. LENOWISCO PLANNING REGION LOCAL ACTION PLAN SUMMARY

WILDLIFE ACTION PLAN AND LOCAL SUMMARIES OVERVIEW

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

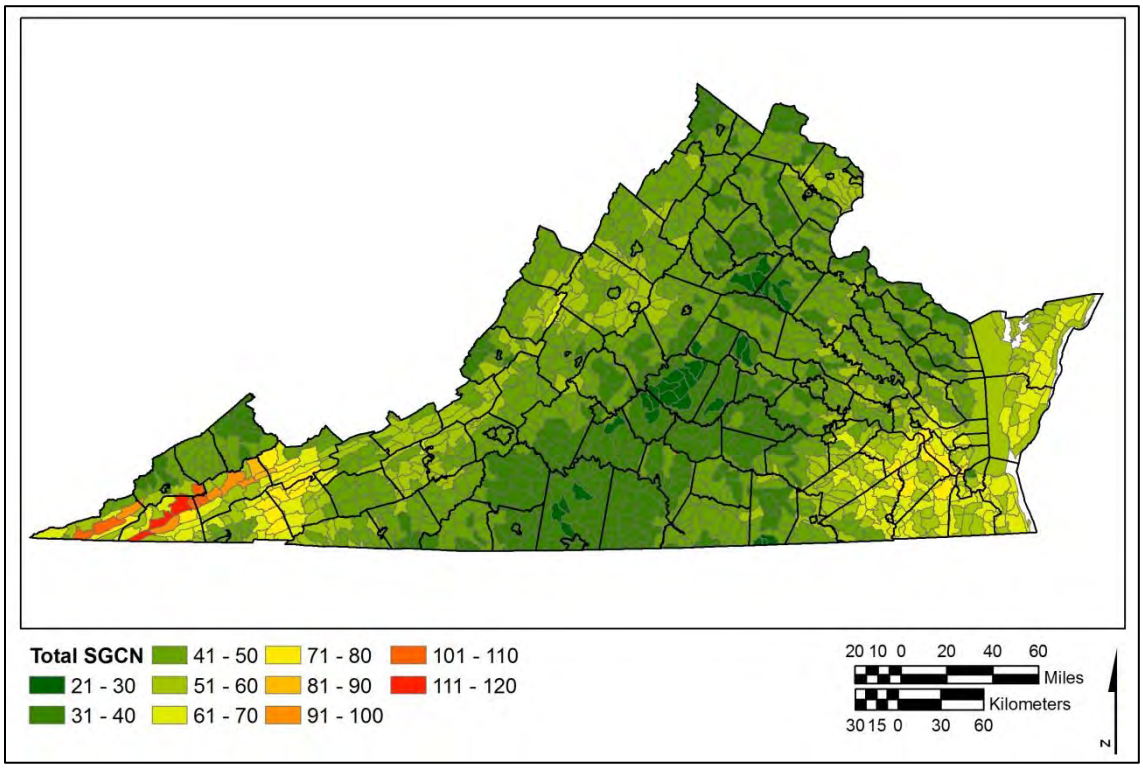

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

LENOWISCO Planning Region Summary Overview

The LENOWISCO Planning Region consists of 888,684 acres (1,389 square miles) and includes the counties of Lee, Scott, and Wise; city of Norton; and towns of Jonesville, Pennington Gap, St. Charles, Clinchport, Duffield, Dungannon, Gate City, Weber City, Nickelsville, Appalachia, Big Stone Gap, Coeburn, Pound, St. Paul, and Wise. The human population in this planning region is estimated to be over 91,000 people. Human populations in all counties and localities have been decreasing. They are not projected to increase (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including 50 SGCN that have 100 percent of their distribution within LENOWISCO Planning Region. A large majority of these species depend on karst cave and spring habitats. Example species include: Finley's cave amphipod, rayed bean, long-headed cave beetle, Powell River crayfish, pink mucket, Dromedary pearlymussel, and blackside dace. The region also includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

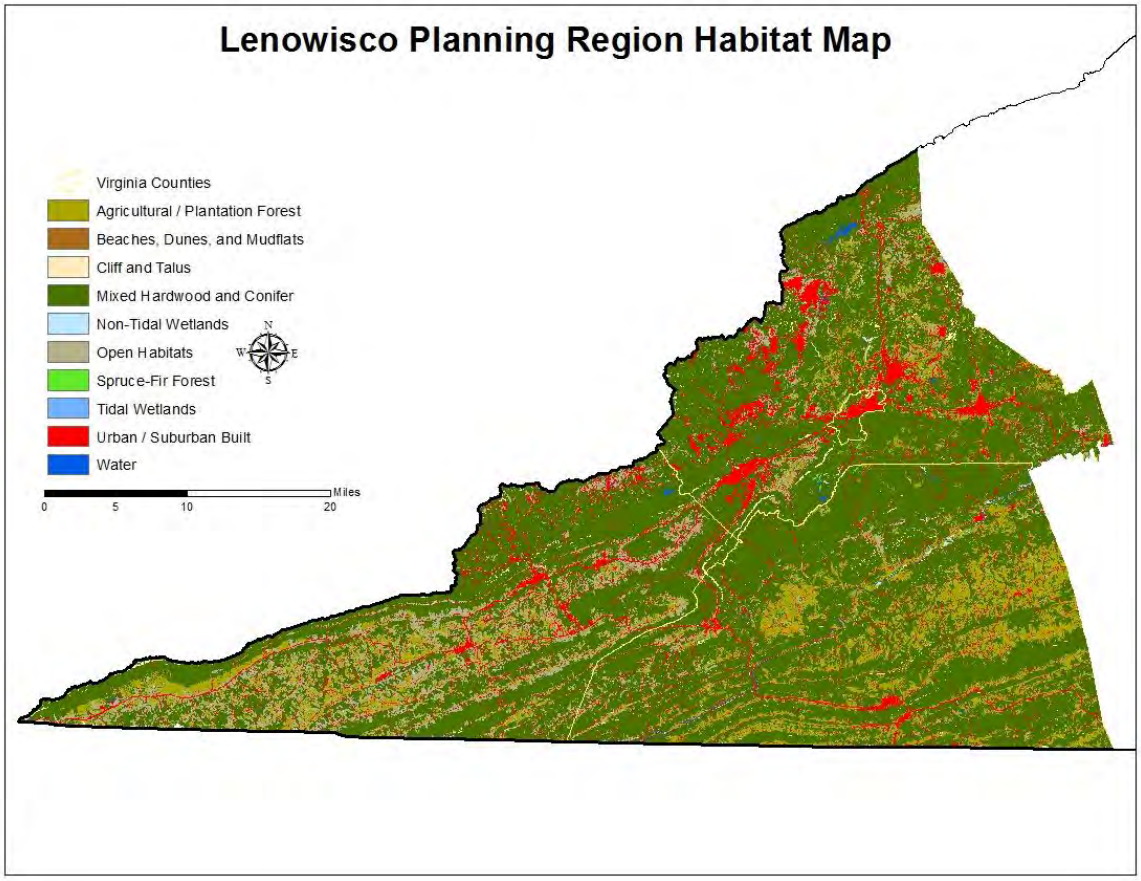

Figure 2. LENOWISCO Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 178 are believed to either occur, or have recently occurred, within LENOWISCO Planning Region (Appendix A). Of these 179 species, ***161 SGCN are dependent upon habitats provided within LENOWISCO Planning Region (Table2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 160 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species

that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	24
Ib	7
Ic	8
IIa	11
IIb	2
IIc	32
IIIa	8
IIIb	6
IIIc	14
IVa	17
IVb	9
IVc	23

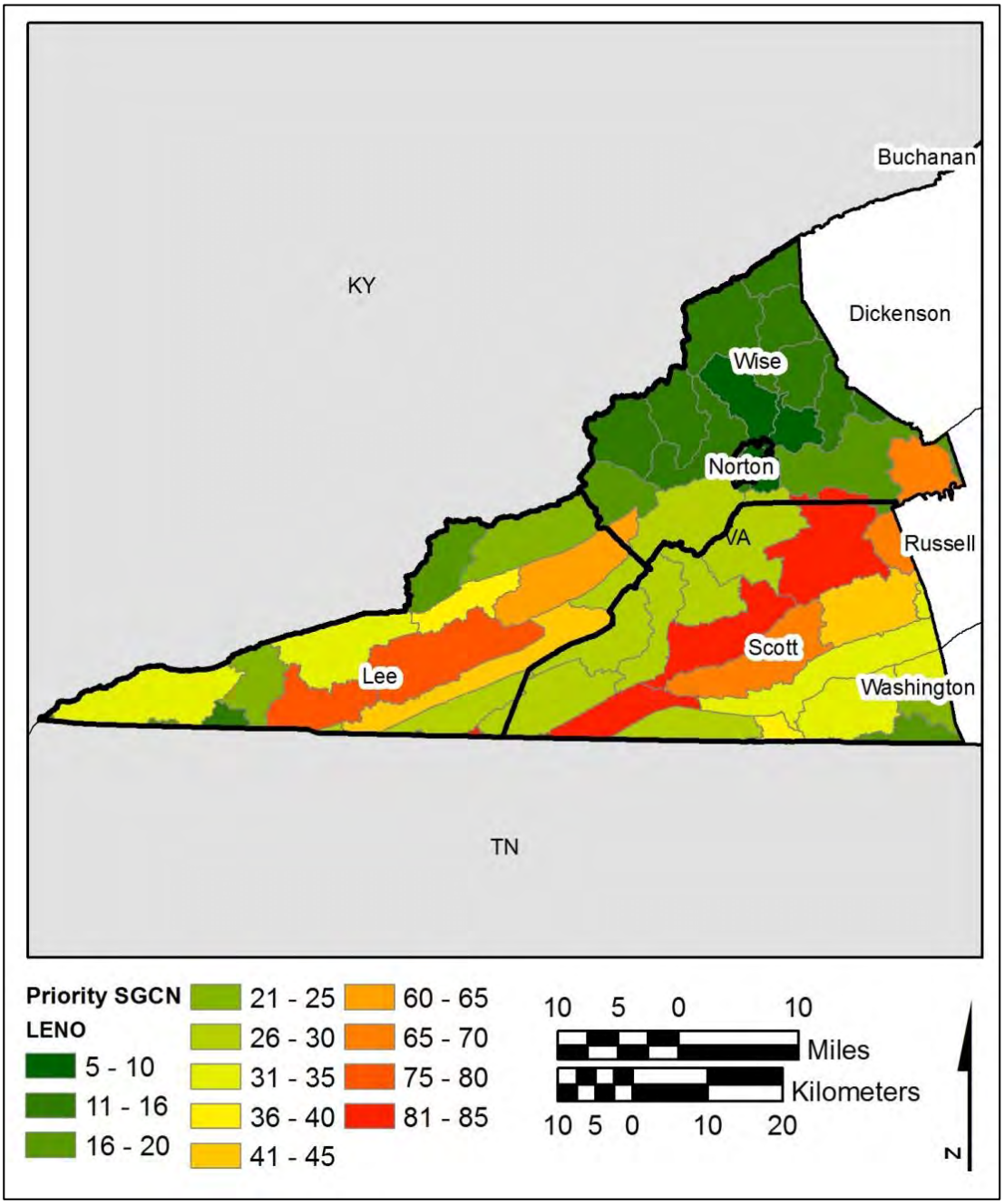

Figure 3. Priority SGCN Density in LENOWISCO Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within LENOWISCO Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*	Mature hardwood forests in the vicinity of rocky outcrops
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Clean streams and rivers with rocky substrates
Amphibian		II	b	Green salamander	*Aneides aeneus*	Damp, but not wet, crevices in shaded rock outcrops and ledges in forested areas
Amphibian		II	a	Mountain chorus frog	*Pseudacris brachyphona*	Forested areas up to 3500 feet that contain suitable breeding sites
Amphibian		II	c	Southern zigzag salamander	*Plethodon ventralis*	Hardwood forests in the vicinity of rocky outcrops
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth.
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes

Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*	Forested moist lower slopes with a rhododendron shrub layer
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FSSE**	I	c	Big Sandy Crayfish	*Cambarus veteranus*	Warm streams with fast flows and bedrock, cobble, boulder, and sand substrates
Crustacean		II	c	Cumberland cave amphipod	*Stygobromus cumberlandus*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	I	c	Cumberland Gap cave amphipod	*Bactrurus angulus*	Caves with clean abundant water flowing through the system

Crustacean	**FS**	II	c	Cumberland Gap cave isopod	*Caecidotea cumberlandensis*	Caves with clean abundant water flowing through the system
Crustacean		II	c	Finley's cave amphipod	*Stygobromus finleyi*	Caves with clean abundant water flowing through the system
Crustacean		II	c	Lee County cave amphipod	*Stygobromus leensis*	Caves with clean abundant water flowing through the system
Crustacean	**FESE**	III	c	Lee County cave isopod	*Lirceus usdagalun*	Caves with clean abundant water flowing through the system
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*	Clean creeks and streams with sand, gravel, clay, or silt substrates
Crustacean	**FS**	II	c	Powell Valley terrestrial isopod	*Amerigoniscus henroti*	Caves with clean abundant water flowing through the system
Crustacean		III	c	Reticulate crayfish	*Orconectes erichsonianus*	Streams with rocky substrates
Crustacean	**FS**	I	a	Rye Cove isopod	*Lirceus culveri*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	II	c	Spiny scale crayfish	*Cambarus jezerinaci*	High elevation high gradient spring fed streams
Crustacean		IV	c	Surgeon crayfish	*Orconectes forceps*	Streams with rocky substrates
Fish	**FS**	I	b	Ashy darter	*Etheostoma cinereum*	Clear cool or warm streams with moderate gradient with rubble and boulder substrates
Fish		IV	c	Blotched chub	*Erimystax insignis*	Clean, cool to warm, streams and rivers with moderate gradient and clean gravel and rubble substrates
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*	Clear warm streams and rivers with moderate gradient with silt free gravel, rubble, or boulder substrates
Fish		IV	c	Brook silverside	*Labidesthes sicculus*	Clear cool or warm lakes and large rivers and can tolerate various substrates and various amounts of aquatic vegetation
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish		IV	c	Bullhead minnow	*Pimephales vigilax*	Pools, backwaters, and quiet runs of small to large rivers having continuous flow and low to moderate gradient, over sand, silt, or gravel
Fish		III	c	Channel darter	*Percina copelandi*	Warm rivers with moderate to swift flows and gravel and rubble substrate
Fish	**FS**	III	c	Clinch sculpin	*Cottus sp. 4*	Cold clear spring runs to rivers with moderate to high gradients and unsilted gravel, rubble, and boulder substrates
Fish		III	c	Common mudpuppy	*Necturus maculosus maculosus*	Permanent lakes, ponds, impoundments, streams, and rivers with suitable hiding cover
Fish		IV	c	Dusky darter	*Percina sciera*	Warm streams and rivers with low gradients and unsilted gravel

						substrates
Fish	**FESE**	I	a	Duskytail darter	*Etheostoma percnurum*	Clear, warm, moderate gradient intermontane streams and rivers with clean gravel, rubble, or boulder substrates
Fish	**ST**	IV	c	Emerald shiner	*Notropis atherinoides*	Clear large streams and rivers with low gradient
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*	Warm turbid water in lakes, reservoirs, and pools in low gradient rivers over mud substrate
Fish		IV	c	Logperch	*Percina caprodes*	Warm, moderate gradient, streams and rivers with gravel and rubble substrates
Fish		III	c	Mirror shiner	*Notropis spectrunculus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*	Cool creeks or streams with moderate flow and clean substrates with access to pool sediments and muddy banks for ammocoetes
Fish		IV	c	Mountain madtom	*Noturus eleutherus*	Clear, warm streams and rivers with gravel and rubble substrates and vegetated riffles
Fish		IV	c	Mountain shiner	*Lythrurus lirus*	Typically in clear, flowing, riffle-pool type creeks and small rivers with moderate gradients and bottom materials ranging from sand- gravel to rubble-boulder
Fish		IV	c	Northern studfish	*Fundulus catenatus*	Cutoff pools, backwaters, and sluggish margins of clear, warm, moderate gradient creeks, streams and rivers with a variety of substrates
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*	Large warm rivers with clean gravel and rubble substrates and access to low gradient areas with soft substrates and detrital material for ammocoetes
Fish	**ST**	IV	c	Paddlefish	*Polyodon spathula*	Warm medium to large rivers with very low flows
Fish		II	c	Popeye shiner	*Notropis ariommus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		III	b	River redhorse	*Moxostoma carinatum*	Clean streams and rivers with unsilted gravel, rubble, and boulder substrates
Fish		IV	c	Sand shiner	*Notropis stramineus*	Warm streams with low to moderate gradient and clean sand and gravel substrates
Fish		III	b	Sauger	*Sander canadensis*	Cool large streams, rivers, and lakes with a combination of deep swift runs and backwaters
Fish	**FTST**	I	c	Slender chub	*Erimystax cahni*	Clear, open, and swift streams and rivers with unsilted gravel substrates
Fish		IV	c	Speckled darter	*Etheostoma stigmaeum*	Aquatic
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*	Clean medium sized streams and rivers with clean gravel and cobble substrate
Fish	**ST**	III	c	Steelcolor shiner	*Cyprinella whipplei*	Warm low to moderate gradient streams and rivers over a variety of substrates

Fish		IV	c	Stonecat	*Noturus flavus*	Warm streams and rivers with moderate to low gradient with rocky substrates
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*	Cool clear streams with moderate to high gradient with clean gravel, rubble, and boulder substrates
Fish		IV	c	Tangerine darter	*Percina aurantiaca*	Clean, cool and warm streams and rivers with moderate gradient and a variety of substrates
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*	Clean creeks with rock, gravel, or silt substrates and stable banks
Fish	**SE**	I	a	Variegate darter	*Etheostoma variatum*	Warm to cool water streams with clean gravel, rubble, or boulder substrates
Fish	**ST**	IV	c	Western sand darter	*Ammocrypta clara*	Warm, low and moderate gradient rivers with sand and sand-gravel substrates
Fish		III	c	Wounded darter	*Etheostoma vulneratum*	Warm moderate gradient streams and rivers with clean gravel and rubble substrate
Fish	**FTST**	I	a	Yellowfin madtom	*Noturus flavipinnis*	Warm, clear streams and rivers with moderate gradient and variety of cover types
FW Mollusk	**FESE**	I	a	Appalachian monkeyface	*Quadrula sparsa*	Medium sized rivers with moderate flow velocity, shallow depth, and mixed substratum of gravel, sand and cobble
FW Mollusk	**FESE**	I	a	Birdwing pearlymussel	*Lemiox rimosus*	Aquatic
FW Mollusk	**ST**	III	a	Black sandshell	*Ligumia recta*	Medium to large rivers with strong currents and sand, gravel, and cobble substrates
FW Mollusk		III	c	Brown walker	*Pomatiopsis cincinnatiensis*	Amphibious - vegetated banks of streams, creeks, and rivers
FW Mollusk		II	c	Coal elimia	*Elimia aterina*	Little is known about this species' habitat needs. It is found in flowing water in the Clinch and Powell Rivers
FW Mollusk	**FESE**	I	b	Cracking pearlymussel	*Hemistena lata*	Medium sized rivers with moderate current and mud, sand, and fine gravel substrates
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk	**FESE**	I	a	Cumberland bean	*Villosa trabalis*	Clear, warm streams and small rivers with moderate to swift currents and unsilted sand, gravel, and rubble substrates
FW Mollusk		IV	a	Cumberland moccasinshell	*Medionidus conradicus*	Small headwater streams with sand and gravel substrates and extends well into medium sized rivers
FW Mollusk	**FESE**	I	a	Cumberland monkeyface	*Quadrula intermedia*	Small to medium sized streams with fast current and silt-free sand, gravel, and rubble substrates
FW Mollusk	**FESE**	I	a	Cumberlandian combshell	*Epioblasma brevidens*	Large creeks to large rivers with gravel, cobble, and boulder substrates

FW Mollusk	**SE**	III	b	Deertoe	*Truncilla truncata*	This species is a generalized in terms of substrate preference, usually occurring in fine gravel mixed with sand and mud. It is also considered a generalist in terms of the size of rivers it inhabits. It is more common in medium-sized rivers but may become numerous in large rivers, where it can live at depths of 12 to 18 feet. It will also establish viable populations in lakes lacking current
FW Mollusk	**FESE**	I	a	Dromedary pearlymussel	*Dromus dromas*	Clean fast moving water with firm, unsilted, sand and gravel substrates
FW Mollusk	**SE**	III	a	Elephant ear	*Elliptio crassidens*	Large creeks to rivers with moderate to swift currents and mud, sand, or rocky substrates
FW Mollusk		II	c	Elktoe	*Alasmidonta marginata*	Small shallow rivers with moderately fast current and sand and gravel substrates
FW Mollusk	**FESE**	I	a	Fanshell	*Cyprogenia stegaria*	Mixed substrates of gravel, sand and cobble
FW Mollusk	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*	Clear high gradient streams in unsilted gravel and cobble substrates
FW Mollusk	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*	Small to medium rivers with swift current and sand, gravel, or cobble substrates
FW Mollusk	**ST**	IV	b	Fragile papershell	*Leptodea fragilis*	This species is tolerant of a variety of aquatic habitats and can be found in small streams in strong current with coarse gravel and sand substrates but also rivers or river-lakes possessing slow current and a firm substrate composed of sand and mud. It can occur at depths of up to 15 or 20 feet but reaches greatest population density at normal water levels of three feet or less in areas such as shallow embayments
FW Mollusk		I	a	Golden riffleshell	*Epioblasma florentina aureola*	Aquatic
FW Mollusk	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*	High gradient headwater streams
FW Mollusk		III	a	Longsolid	*Fusconaia subrotunda*	Medium to large rivers with strong currents and sand and gravel substrates
FW Mollusk		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*	Very clean small headwaters creeks and streams with sand and gravel substrates and associated with *Justicia* beds
FW Mollusk	**SE**	III	c	Ohio pigtoe	*Pleurobema cordatum*	Medium and large rivers with flow with gravel, cobble, and boulder substrates, but can also tolerate some reservoir environments
FW Mollusk	**FESE**	I	a	Oyster mussel	*Epioblasma capsaeformis*	Warm creeks and rivers with moderate to swift current and sand, gravel, and boulder substrates
FW Mollusk	**ST**	IV	b	Pimple back	*Quadrula pustulosa pustulosa*	This species has generalized habitat preferences and can maintain abundant and viable populations in shallow to deep sections of large reservoirs as well as in small to medium-sized free-flowing rivers. It is usually found in a substrate consisting of coarse gravel, sand, and silt
FW Mollusk		III	b	Pink heelsplitter	*Potamilus alatus*	On a variety of substrates in slow to swiftly flowing wate

FW Mollusk	**FESE**	I	a	Pink mucket	*Lampsilis abrupta*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk		IV	c	Proud globe snail	*Mesodon elevatus*	Calcareous river bluffs and ravines with oak, maple, hickory, or sycamore
FW Mollusk	**FESE**	I	a	Purple bean	*Villosa perpurpurea*	Headwaters, creeks, and rivers and can tolerate a variety of currents and substrates
FW Mollusk	**FSSE**	II	a	Pyramid pigtoe	*Pleurobema rubrum*	Medium and large rivers with flow and stable mud or mud/sand substrates
FW Mollusk	**FP**	II	a	Rayed bean	*Villosa fabalis*	Flowing water in headwater creeks with sand and gravel substrates and vegetation
FW Mollusk	**FESE**	I	a	Rough pigtoe	*Pleurobema plenum*	Medium to large rivers with sand, gravel, and cobble substrates
FW Mollusk	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*	Warm medium to large rivers with swift currents and silt, sand, gravel, or cobble substrates
FW Mollusk	**FPST**	II	a	Sheepnose	*Plethobasus cyphyus*	Warm large rivers and reservoirs with gravel and cobble substrates
FW Mollusk	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*	Moderate to swift current with stable sand, gravel, or cobble substrates
FW Mollusk	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*	Large creeks to moderate rivers with moderate flow and gravel and sand substrates
FW Mollusk	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*	Headwater creeks and small streams with constant flow and mud, sand, or gravel substrates and aquatic vegetation
FW Mollusk	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*	Small to medium sized creeks with swift current and sand, gravel, and cobble substrates
FW Mollusk	**FPSE**	I	b	Spectaclecase	*Cumberlandia monodonta*	Under slab rocks or in crevices beneath bedrock shelves
FW Mollusk	**SE**	II	c	Spider Elimia	*Elimia arachnoidea*	Little is known about this species' habitat needs. It has only been found in small streams
FW Mollusk	**FSST**	III	a	Spiny riversnail	*Io fluvialis*	Large rocks and bedrock outcrops in well-oxygenated shallow water with fast current
FW Mollusk		III	a	Tennessee clubshell	*Pleurobema oviforme*	Creeks and small rivers with moderate flow and sand/ gravel substrates
FW Mollusk	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*	Small headwater streams with sand or mud substrates
FW Mollusk	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*	Headwater streams to rivers with moderate to high flow and unsilted gravel/ sand rubble, or boulder substrates
FW Mollusk		IV	c	Three-ridge valvata	*Valvata tricarinata*	Unknown habitat needs in Virginia but in other parts of the country this species is associated with aquatic vegetation
FW Mollusk	**FSSE**	I	a	Unthanks Cave snail	*Holsingeria unthanksensis*	Karst obligate that requires clean water flowing through the system

Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus seclusus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*	Caves with clean abundant water flowing through the system.
Insect	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*	Small shady spring fed streams with mud bottoms
Insect	**FS**	II	c	Cumberland Gap cave beetle	*Pseudanophthalmus hirsutus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Deceptive cave beetle	*Pseudanophthalmus deceptivus*	Caves with clean abundant water flowing through the system
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*	Large rivers with rocks and moderate current
Insect	**FSSE**	I	c	Holsinger's cave beetle	*Pseudanophthalmus holsingeri*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Little Kennedy Cave beetle	*Pseudanophthalmus cordicollis*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Lobed roachfly	*Tallaperla lobata*	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect	**FS**	II	c	Long-headed cave beetle	*Pseudanophthalmus longiceps*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Overlooked cave beetle	*Pseudanophthalmus praetermissus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Rotund cave beetle	*Pseudanophthalmus rotundatus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Saint Paul cave beetle	*Pseudanophthalmus sanctipauli*	Caves with clean abundant water flowing thru the system.
Insect	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Thomas' cave beetle	*Pseudanophthalmus thomasi*	Caves with clean abundant water flowing through the system
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*	Blue Ridge to the west - cliffs dry rocky slopes, talus, and exposed ridges
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred, though sometimes deeper locations are used. Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.

Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*	Winter roosts are in deep vertical caves with domed halls. Large summer colonies utilize caves that trap warm air and provide restricted rooms or domed ceilings; maternity caves often have a stream flowing through them and are separate from the caves used in summer by males. Forage along steams flowing through forested areas.
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests
Other Aquatic Invertebrate	**FS**	I	c	Powell Valley planarian	*Sphalloplana consimilis*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius binoculatus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius proximosetus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius similis*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Brachoria dentata*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Cedar millipede	*Brachoria cedra*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Gertsch's cave pseudoscorpion	*Kleptochthonius gertschi*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Lutz's cave pseudoscorpion	*Kleptochthonius lutzi*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Valentine's cave pseudoscorpion	*Microcreagris valentinei*	Caves with clean abundant water flowing through the system
Reptile		III	c	Cumberland slider	*Trachemys scripta troostii*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches

Reptile	III	c	Eastern black kingsnake	*Lampropeltis getula nigra*	This species is known to utilize various habitats including Dry rocky hills, open woods, dry prairies, stream valleys, and many other habitats.
Reptile	IV	a	Northern map turtle	*Graptemys geographica*	Clear flowing water with gravel substrates
Reptile	IV	a	Spiny softshell	*Apalone spinifera spinifera*	Clean clear rivers with flowing water and sand substrates
Reptile	IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*	Warm streams with fast flows and rock and cobble substrates

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the LENOWISCO Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national forests to state parks and wildlife management areas to conservation easements. Significant conservation assets, in terms of size, include:

- George Washington and Jefferson National Forests,
- Cumberland Gap National Historical Park,
- Natural Tunnel State Park,
- Wilderness Road State Park, and
- The Cedars State Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

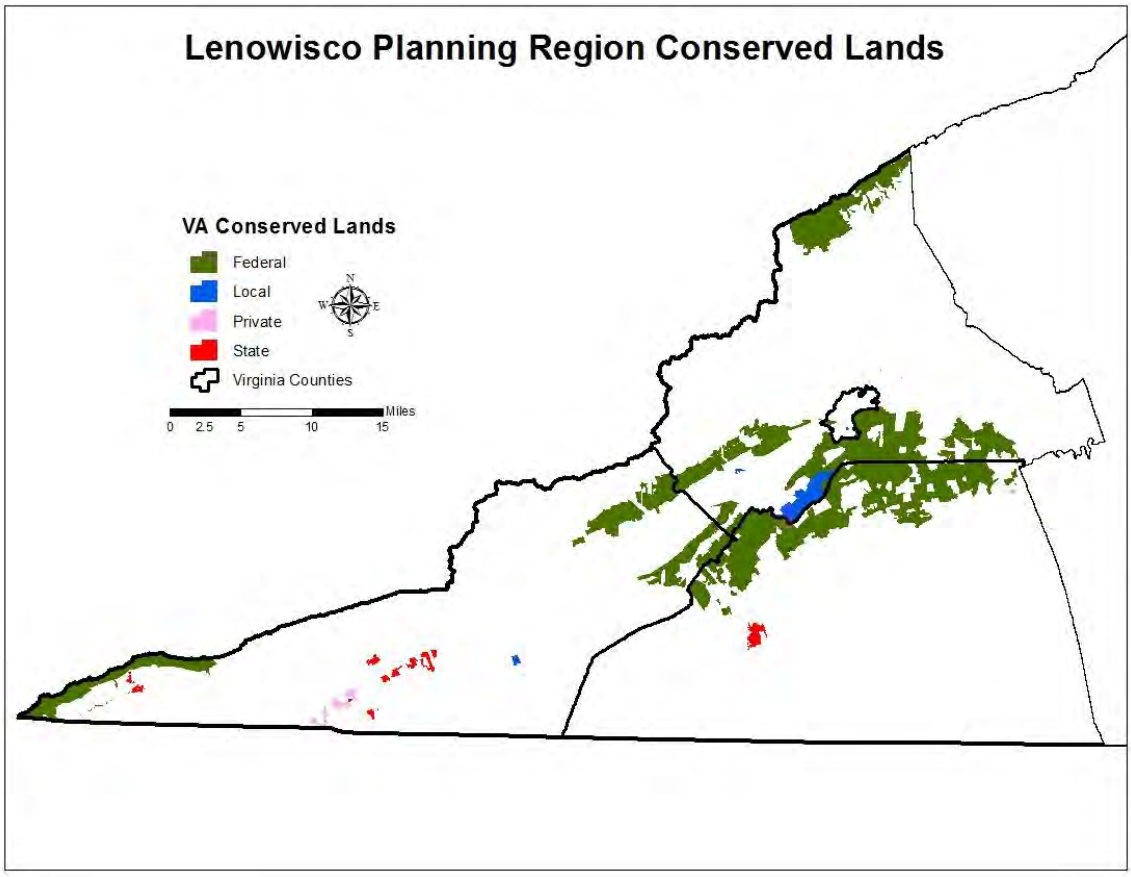

Figure 4. Conservation Lands in LENOWISCO Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Crater Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the LENOWISCO Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the LENOWISCO Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the Appalachians than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

CONSERVATION THREATS AND ACTIONS FOR WILDLIFE AND HABITATS IN THE LENOWISCO PLANNING REGION

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many LENOWISCO Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary Conservation Strategies and Actions for LENOWISCO Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Commercial/residential water consumption, sedimentation and pollutants; protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology. Additional areas include Rye Cove, Cedar and Copper Creek
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetative and/ or forested buffers along streams and sinkholes as well as in agricultural, urban and residential areas; 2) Restore/stabilize eroding stream banks; 3) Reclaim/ revegetate disturbed forest lands and abandoned mine lands; 4) Exclude livestock from streams; 5) Improve pasture and loafing lot management to prevent manure-tainted runoff from flowing into streams; 6) Repair or replace failing septic systems and eliminating "straight pipes;" 7) Implement urban storm water management BMPs; 8) Preventing pet waste from entering streams; 9) Continue to identify impaired waters within the planning region; 10) Remove barriers to aquatic connections; 11) Monitor and address invasive species impacts; and 12) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Big Moccasin Creek, Blue Springs Branch, Cove Creek, Dowell Branch, Hiltons Creek, North Fork Holston River, Possum Creek, Guest River, Straight Creek Additional creeks that support a high number of SGCN include: Copper Crek, Clinch River, Powell River, Wallen Creek, Blackwater Creek, maybe Town Creek

Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; 5) Conduct prescribed burns; 6) Monitor and control invasive species; and 7) Conduct pest and pathogen control.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels ; ridge to ridge forested connectors through valleys
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems; game animal habitat support (quail, grouse, rabbits, deer, elk)	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The LENOWISCO Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for many SGCN, including the Finley's cave amphipod, rotund cave beetle, deceptive cave beetle, Powell Valley planarian, and a wide variety other important species. Others species such as the Indiana bat depend on karst habitat and are endangered throughout their range. Caves in this planning region provide crucial winter habitat for some bat species.

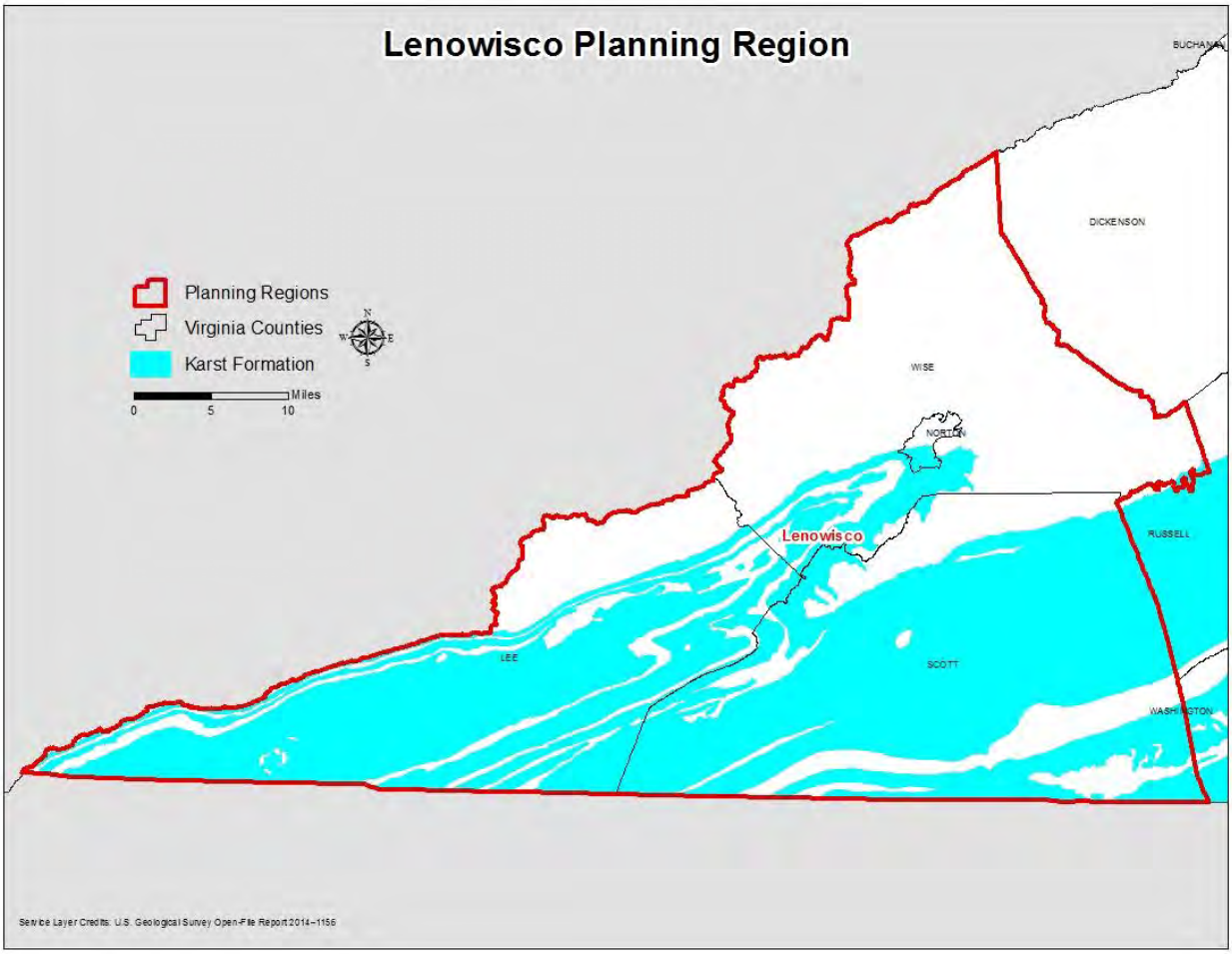

Figure 5. Karst Areas in LENOWISCO Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems is affected

by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites. Development and resulting pollutant-laden runoff also negatively affect water quality (DCR 2008).

2. Altered Hydrology: Development, which also likely plays a role in degraded water quality in the areas where karst occurs, can also result in altered hydrology which can affect water quantity and flows. The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats, diminish cave hydrology and humidity, and change surface topography.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces. It is important to note, however, that while the overall contaminants loading may increase during storm events, the actual concentrations to which animals and plants are exposed often go down during storm events. If these contaminants are not deposited instream, they may not become highly bioavailable and have a relatively lower impact.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

To ensure adequate water quantity in karst areas, vegetative buffers around sinkholes and entrances will also be helpful as well as maintaining vegetative cover in areas underlain by karst geology. At the time of this writing, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas. Working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001).

Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances

could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change. If precipitation and storm events become more intense, then there likely will be more storm water runoff.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the LENOWISCO Planning Region include cold and warm water rivers, streams, and creeks. Large river systems include the Clinch, Holston, and Powell Rivers. Approximately 2,815 acres (0.32 percent) of the planning region are considered aquatic (Anderson et al. 2013). Additionally, over 90 percent of the planning region's SGCN are aquatic. These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the rayed bean, Powell River crayfish, blackside dace, Western sand darter, brook trout, pink mucket (pearlymussel), paddlefish, and dromedary pearlymussel.

Threats

Aquatic and riparian habitats within the LENOWISCO Planning Region face multiple threats from water quality related issues to issues related to habitat destruction and bank destabilization to invasive species.

1. Water Quality Degradation: Pollution is a significant threat to aquatic species and riparian habitats within the LENOWISCO Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed

watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although LENOWISCO has some areas with a high percentage of impervious surface cover, the majority of the planning region has a low percentage of impervious surface cover (Figure 6).

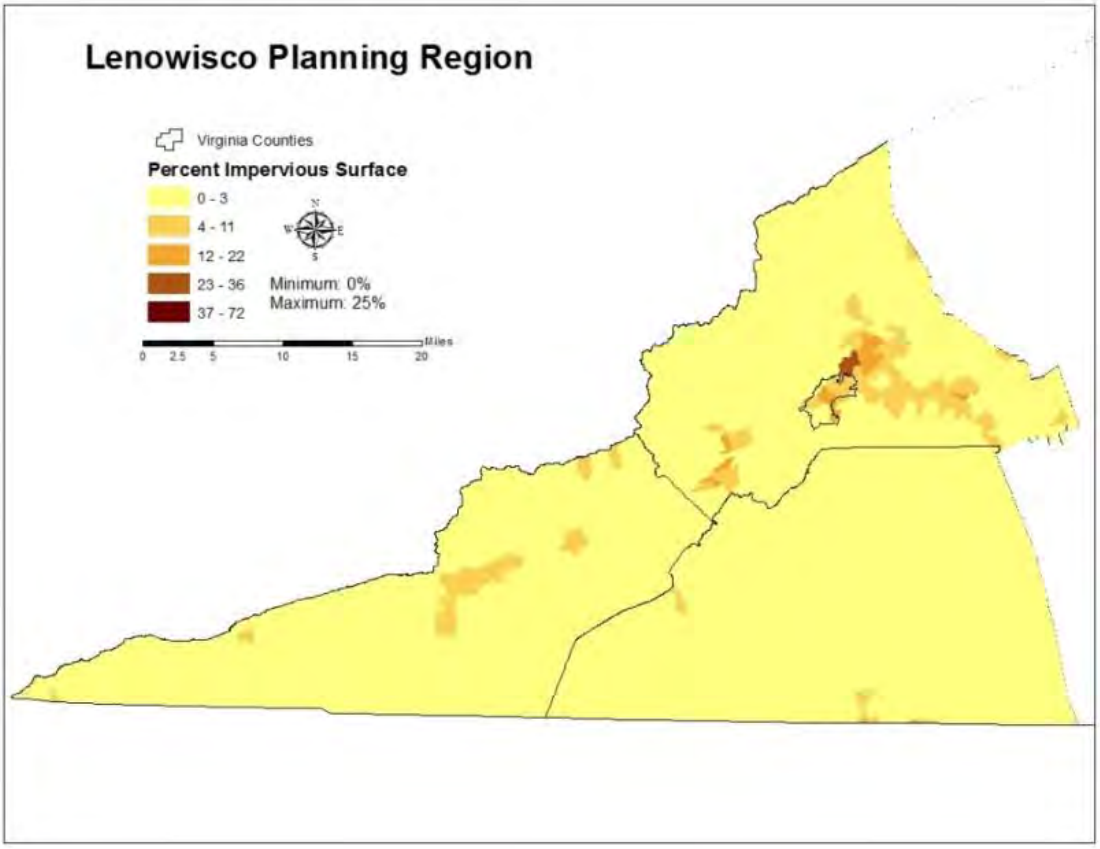

Figure 6. Impervious Surface Cover in Cumberland Plateau Planning Region (SARP 2014).

3. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

4. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but

invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

5. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014). Streams may also become more alkaline due to mine runoff and underground mine pumping, which can also alter stream habitat.

6. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures, both in terms of absolute levels and the timing of peaks and gradients.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Big Moccasin Creek, Blue Springs Branch, Cove Creek, Dowell Branch, Hiltons Creek, North Fork Holston River, and Possum Creek (MapTech 2013); Guest River (Lonesome Pine Soil and Water Conservation District 2014); and Straight Creek (Virginia Mining Issues Group 2007) (Figure 7).

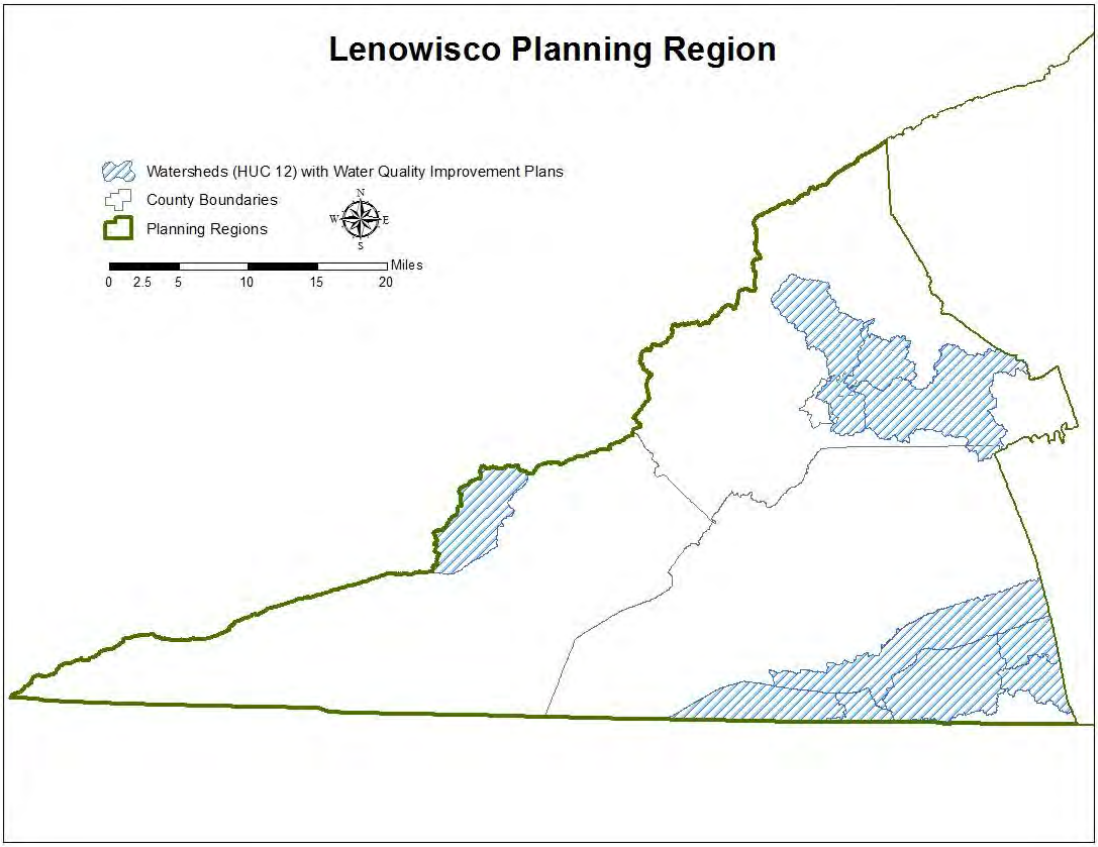

Figure 7. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetative and/ or forested buffers along streams and sinkholes as well as in agricultural, urban and residential areas;
- Restoring/stabilizing eroding stream banks
- Reclaiming/revegetating disturbed forest lands; a
- Excluding livestock from streams;
- Improving pasture and loafing lot management to prevent manure-tainted runoff from flowing into streams;
- Repairing or replacing failing septic systems and eliminating “straight pipes” discharging human waste into streams;
- Implementing storm water management BMPs;
- Restoring/reclaiming abandoned mine lands; and
- Preventing pet waste from entering streams.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices

(Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 8).

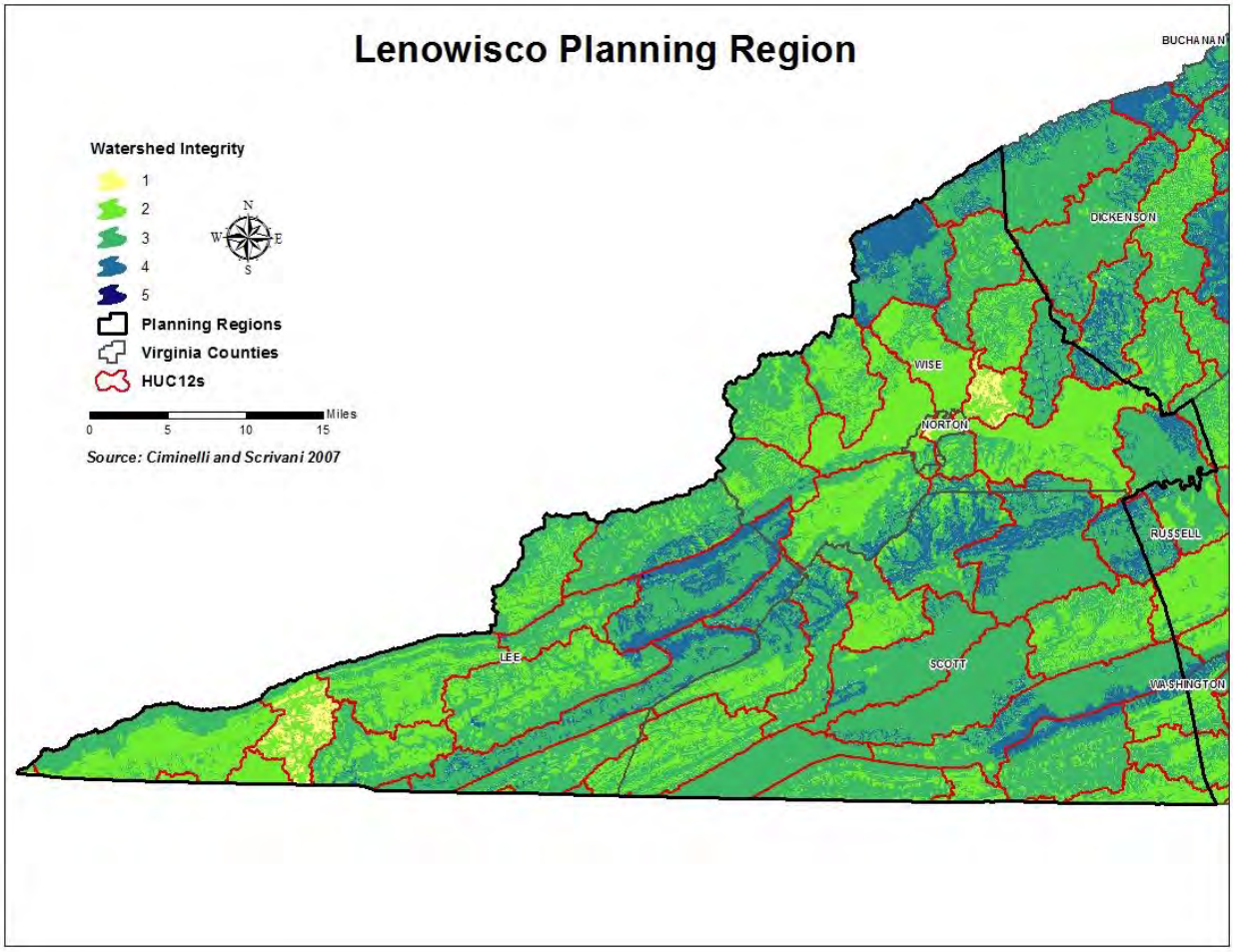

Figure 8. Watershed Integrity Model for LENOWISCO Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the LENOWISCO Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS

and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the LENOWISCO Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they accommodate predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up approximately two thirds of the LENOWISCO Planning Region and are important for a broad range of species (Table 4). Within this forest type, young forests make up a specific age class of forest, loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods and conifers. These forests help protect water resources within the region and provide habitat for species such as the proud globe snail, green salamander, southern zigzag salamander, mountain chorus frog, Swainson's warbler, cerulean warbler, ruffed grouse and Indiana bat in the summer months, among other species.

Table 4. Forest Acreage Totals in LENOWISCO Planning Region (Anderson et al. 2013).

Forest Type	Acres	Percent of Planning Region
Spruce Fir	138.33	0.02%
Mixed Hardwood and Conifer	601,609.53	67.69%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the LENOWISCO Planning Region is fragmentation, due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Mining and other extractive uses also degrade habitat and affect species composition and water quality.

2. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

3. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note are the hemlock wooly adelgid and the gypsy moth, which has a significant effect on the ecology of oak-hickory forests (DOF 2014).

4. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires, an increase in incidence of pests, and more damage from wind and ice storms.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the LENOWISCO Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014).

Several agencies, including DGIF, the NRCS, DOF, and the USFS advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the LENOWISCO Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south, east/west, and at high/low elevations between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens and make up approximately 84,750 acres (9.5 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding,

protection, etc. These habitats provide habitat for a variety of birds such as the barn owl, Eastern meadowlark, grasshopper sparrow, among others, within the planning region.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession driven by a loss of natural or historical disturbance regimes (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, autumn olive, and privet. These species can out-compete native open habitat species and take over the landscape. Some such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, managed grazing, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). For pine savannas, thinning and prescribed burns are critical to preserve this open habitat.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). Climate change also may benefit some open habitat areas due to warmer temperatures, drier conditions, and more stress on water demanding plant species. It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-

natives and ensuring a diverse mix of vegetation species. Working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to the greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the LENOWISCO Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN LENOWISCO PLANNING REGION

Complete SGCN list for the LENOWISCO Planning Region (SGCN=178). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibian		III	a	Common mudpuppy	*Necturus maculosus maculosus*
Amphibian		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibian		II	b	Green salamander	*Aneides aeneus*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		II	a	Mountain chorus frog	*Pseudacris brachyphona*
Amphibian		II	c	Southern zigzag salamander	*Plethodon ventralis*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*

Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustaceans	**FSSE**	I	c	Big Sandy Crayfish	*Cambarus veteranus*
Crustaceans		II	c	Cumberland cave amphipod	*Stygobromus cumberlandus*
Crustaceans	**FS**	I	c	Cumberland Gap cave amphipod	*Bactrurus angulus*
Crustaceans	**FS**	II	c	Cumberland Gap cave isopod	*Caecidotea cumberlandensis*
Crustaceans		II	c	Finley's cave amphipod	*Stygobromus finleyi*
Crustaceans		II	c	Lee County cave amphipod	*Stygobromus leensis*
Crustaceans	**FESE**	III	c	Lee County cave isopod	*Lirceus usdagalun*
Crustaceans		III	b	Longclaw crayfish	*Cambarus buntingi*
Crustaceans	**FS**	II	c	Powell Valley terrestrial isopod	*Amerigoniscus henroti*
Crustaceans		III	c	Reticulate crayfish	*Orconectes erichsonianus*
Crustaceans	**FS**	I	a	Rye Cove isopod	*Lirceus culveri*
Crustaceans	**FS**	II	c	Spiny scale crayfish	*Cambarus jezerinaci*
Crustaceans		IV	c	Surgeon crayfish	*Orconectes forceps*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish	**FS**	I	b	Ashy darter	*Etheostoma cinereum*
Fish		IV	c	Blotched chub	*Erimystax insignis*
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*
Fish		IV	c	Brook silverside	*Labidesthes sicculus*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish		IV	c	Bullhead minnow	*Pimephales vigilax*
Fish		III	c	Channel darter	*Percina copelandi*
Fish	**FS**	III	c	Clinch sculpin	*Cottus sp. 4*
Fish		IV	c	Dusky darter	*Percina sciera*
Fish	**FESE**	I	a	Duskytail darter	*Etheostoma percnurum*
Fish	**ST**	IV	c	Emerald shiner	*Notropis atherinoides*
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*

Fish		IV	c	Logperch	*Percina caprodes*
Fish		III	c	Mirror shiner	*Notropis spectrunculus*
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*
Fish		IV	c	Mountain madtom	*Noturus eleutherus*
Fish		IV	c	Mountain shiner	*Lythrurus lirus*
Fish		IV	c	Northern studfish	*Fundulus catenatus*
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*
Fish	**ST**	IV	c	Paddlefish	*Polyodon spathula*
Fish		II	c	Popeye shiner	*Notropis ariommus*
Fish		III	b	River redhorse	*Moxostoma carinatum*
Fish		IV	c	Sand shiner	*Notropis stramineus*
Fish		III	b	Sauger	*Sander canadensis*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
Fish	**FTST**	I	c	Slender chub	*Erimystax cahni*
Fish		IV	c	Speckled darter	*Etheostoma stigmaeum*
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*
Fish	**ST**	III	c	Steelcolor shiner	*Cyprinella whipplei*
Fish		IV	c	Stonecat	*Noturus flavus*
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*
Fish		IV	c	Tangerine darter	*Percina aurantiaca*
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*
Fish	**SE**	I	a	Variegate darter	*Etheostoma variatum*
Fish	**ST**	IV	c	Western sand darter	*Ammocrypta clara*
Fish		III	c	Wounded darter	*Etheostoma vulneratum*
Fish	**FTST**	I	a	Yellowfin madtom	*Noturus flavipinnis*
FW Mollusks	**FESE**	I	a	Appalachian monkeyface	*Quadrula sparsa*
FW Mollusks	**FESE**	I	a	Birdwing pearlymussel	*Lemiox rimosus*
FW Mollusks	**ST**	III	a	Black sandshell	*Ligumia recta*
FW Mollusks		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusks		III	c	Brown walker	*Pomatiopsis cincinnatiensis*
FW Mollusks		II	c	Coal elimia	*Elimia aterina*
FW Mollusks	**FESE**	I	b	Cracking pearlymussel	*Hemistena lata*
FW Mollusks		IV	a	Creeper	*Strophitus undulatus*
FW Mollusks	**FESE**	I	a	Cumberland bean	*Villosa trabalis*
FW Mollusks		IV	a	Cumberland moccasinshell	*Medionidus conradicus*
FW Mollusks	**FESE**	I	a	Cumberland monkeyface	*Quadrula intermedia*
FW Mollusks	**FESE**	I	a	Cumberlandian combshell	*Epioblasma brevidens*

FW Mollusks	**SE**	III	b	Deertoe	*Truncilla truncata*
FW Mollusks	**FESE**	I	a	Dromedary pearlymussel	*Dromus dromas*
FW Mollusks	**SE**	III	a	Elephant ear	*Elliptio crassidens*
FW Mollusks		II	c	Elktoe	*Alasmidonta marginata*
FW Mollusks	**FESE**	I	a	Fanshell	*Cyprogenia stegaria*
FW Mollusks	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*
FW Mollusks	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*
FW Mollusks	**ST**	IV	b	Fragile papershell	*Leptodea fragilis*
FW Mollusks	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*
FW Mollusks		III	a	Longsolid	*Fusconaia subrotunda*
FW Mollusks		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*
FW Mollusks	**SE**	III	c	Ohio pigtoe	*Pleurobema cordatum*
FW Mollusks	**FESE**	I	a	Oyster mussel	*Epioblasma capsaeformis*
FW Mollusks	**ST**	IV	b	Pimple back	*Quadrula pustulosa pustulosa*
FW Mollusks	**FESE**	I	a	Pink mucket	*Lampsilis abrupta*
FW Mollusks		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusks	**FESE**	I	a	Purple bean	*Villosa perpurpurea*
FW Mollusks	**FSSE**	II	a	Pyramid pigtoe	*Pleurobema rubrum*
FW Mollusks	**FP**	II	a	Rayed bean	*Villosa fabalis*
FW Mollusks	**FESE**	I	a	Rough pigtoe	*Pleurobema plenum*
FW Mollusks	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*
FW Mollusks	**FPST**	II	a	Sheepnose	*Plethobasus cyphyus*
FW Mollusks	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*
FW Mollusks	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*
FW Mollusks	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*
FW Mollusks	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*
FW Mollusks	**FPSE**	I	b	Spectaclecase	*Cumberlandia monodonta*
FW Mollusks	**SE**	II	c	Spider Elimia	*Elimia arachnoidea*
FW Mollusks	**FSST**	III	a	Spiny riversnail	*Io fluvialis*
FW Mollusks	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*
FW Mollusks	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*
FW Mollusks		IV	c	Three-ridge valvata	*Valvata tricarinata*
FW Mollusks	**FSSE**	I	a	Unthanks Cave snail	*Holsingeria unthanksensis*
Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus seclusus*
Insect	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*
Insect	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*
Insect	**FS**	II	c	Cumberland Gap cave beetle	*Pseudanophthalmus hirsutus*

Insect	**FS**	II	c	Deceptive cave beetle	*Pseudanophthalmus deceptivus*
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*
Insect	**FSSE**	I	c	Holsinger's cave beetle	*Pseudanophthalmus holsingeri*
Insect	**FS**	II	c	Little Kennedy Cave beetle	*Pseudanophthalmus cordicollis*
Insect	**FS**	II	c	Lobed roachfly	*Tallaperla lobata*
Insect	**FS**	II	c	Long-headed cave beetle	*Pseudanophthalmus longiceps*
Insect	**FS**	II	c	Overlooked cave beetle	*Pseudanophthalmus praetermissus*
Insect	**FS**	II	c	Rotund cave beetle	*Pseudanophthalmus rotundatus*
Insect	**FS**	II	c	Saint Paul cave beetle	*Pseudanophthalmus sanctipauli*
Insect	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*
Insect		III	a	Tennessee clubshell	*Pleurobema oviforme*
Insect	**FS**	II	c	Thomas' cave beetle	*Pseudanophthalmus thomasi*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Aquatic Invertebrates	**FS**	I	c	Powell Valley planarian	*Sphalloplana consimilis*
Other Terrestrial Invertebrates	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius binoculatus*
Other Terrestrial Invertebrates	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius proximosetus*
Other Terrestrial Invertebrates	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius similis*
Other Terrestrial Invertebrates	**FS**	II	c	A millipede	*Brachoria dentata*
Other Terrestrial Invertebrates	**FS**	II	c	Cedar millipede	*Brachoria cedra*
Other Terrestrial Invertebrates	**FS**	II	c	Gertsch's cave pseudoscorpion	*Kleptochthonius gertschi*
Other Terrestrial Invertebrates	**FS**	II	c	Lutz's cave pseudoscorpion	*Kleptochthonius lutzi*
Other Terrestrial Invertebrates		IV	c	Proud globe snail	*Mesodon elevatus*

Other Terrestrial Invertebrates	**FS**	II	c	Valentine's cave pseudoscorpion	*Microcreagris valentinei*
Reptile		III	c	Cumberland slider	*Trachemys scripta troostii*
Reptile		III	c	Eastern black kingsnake	*Lampropeltis getula nigra*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Northern map turtle	*Graptemys geographica*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Spiny softshell	*Apalone spinifera spinifera*
Reptile		IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

13. Middle Peninsula Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

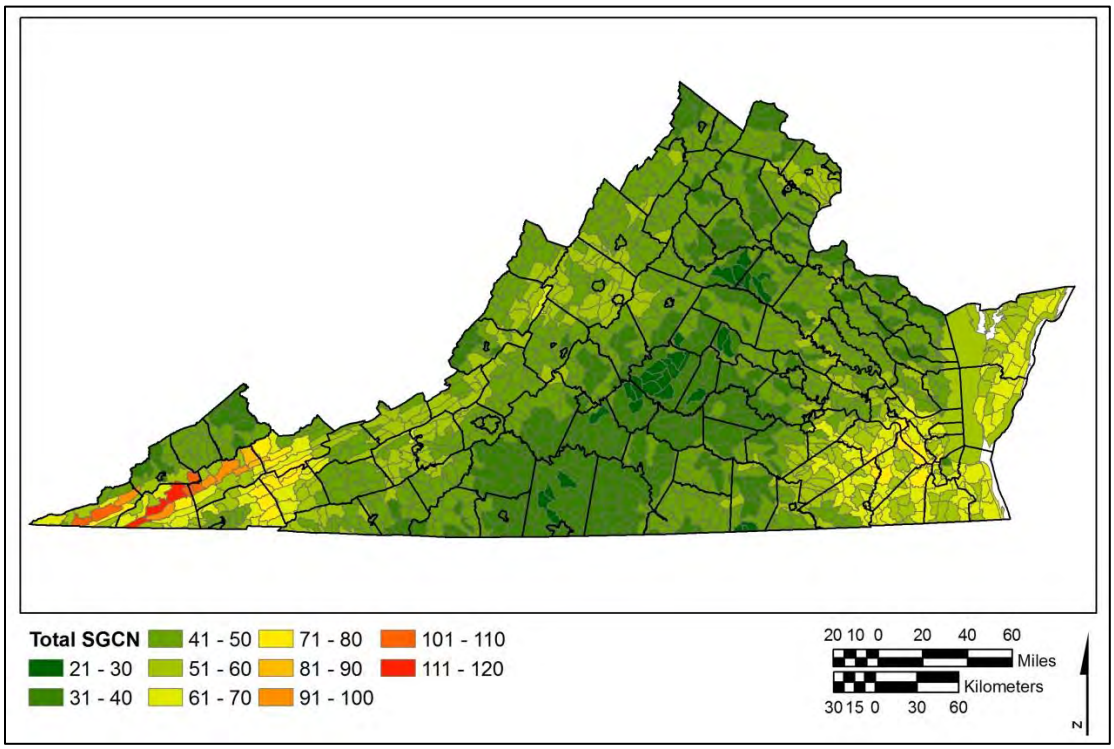

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions (DCR 2013a). Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

MIDDLE PENINSULA PLANNING REGION SUMMARY OVERVIEW

The Middle Peninsula Planning Region is largely rural and consists of 1,058,634 acres (1,654 square miles) and includes the counties of Essex, Gloucester, King and Queen, King William, Mathews, and Middlesex and the towns of Tappahannock, Urbanna, and West Point. The human population in this planning region is estimated to be slightly over 91,000 people. All counties are expected to experience population growth by 2030 (VIMS 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. The aquatic habitats of this planning region are especially important for the migratory Atlantic and shortnose sturgeons and American shad. Its coastal wetlands provide habitat for the rare skipper, clapper rail, king rail, and seaside sparrow. The planning region includes a variety of other habitats such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, tidally influenced and non-tidal streams and riparian habitats, beaches and dunes and mudflats, and estuarine habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

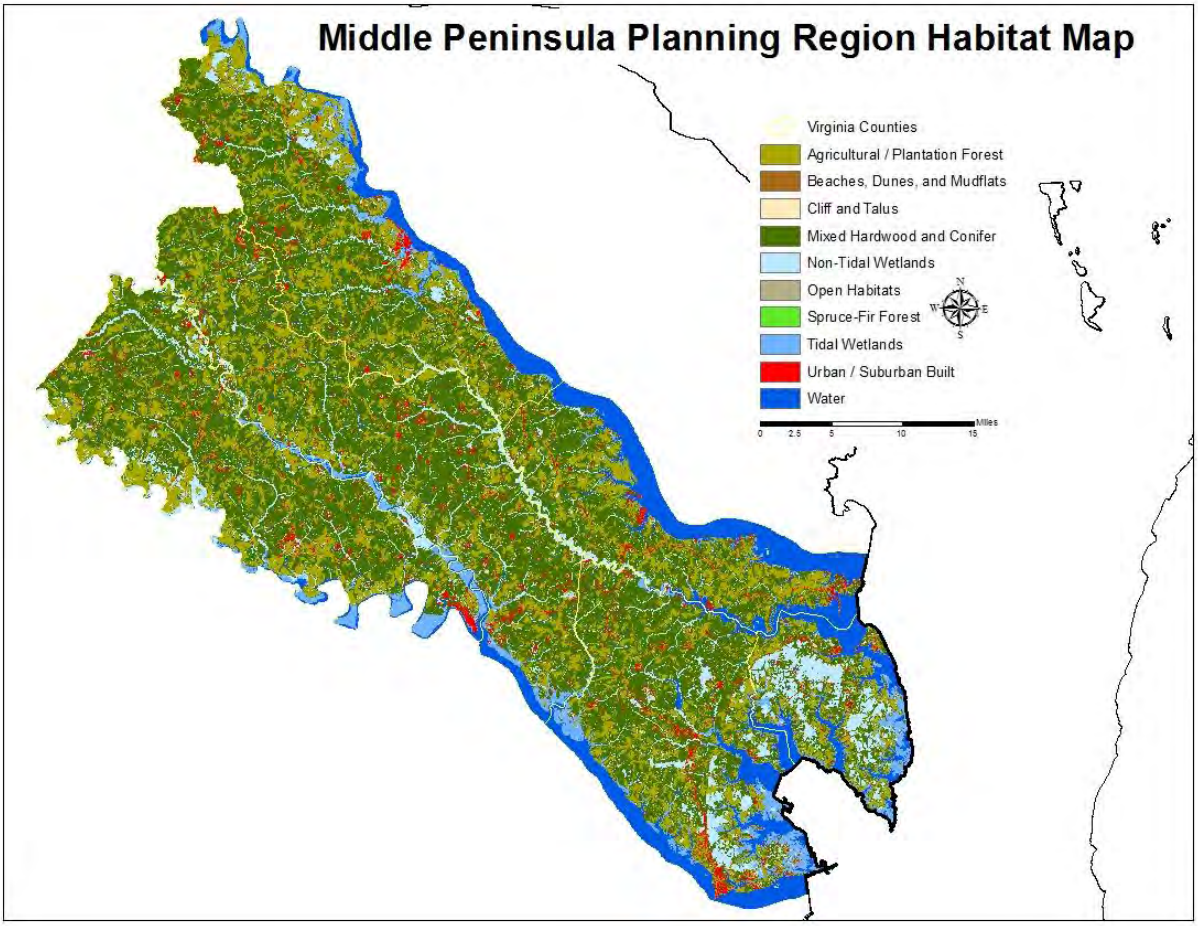

Figure 2. Middle Peninsula Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 100 are believed to either occur, or have recently occurred, within the Middle Peninsula Planning Region (Appendix A). Of these 100 species, **52 *SGCN are dependent upon habitats provided within the Middle Peninsula Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 52 priority species within this planning region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in

three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	5
Ib	2
Ic	1
IIa	2
IIb	1
IIc	1
IIIa	6
IIIb	3
IIIc	1
IVa	14
IVb	10
IVc	6

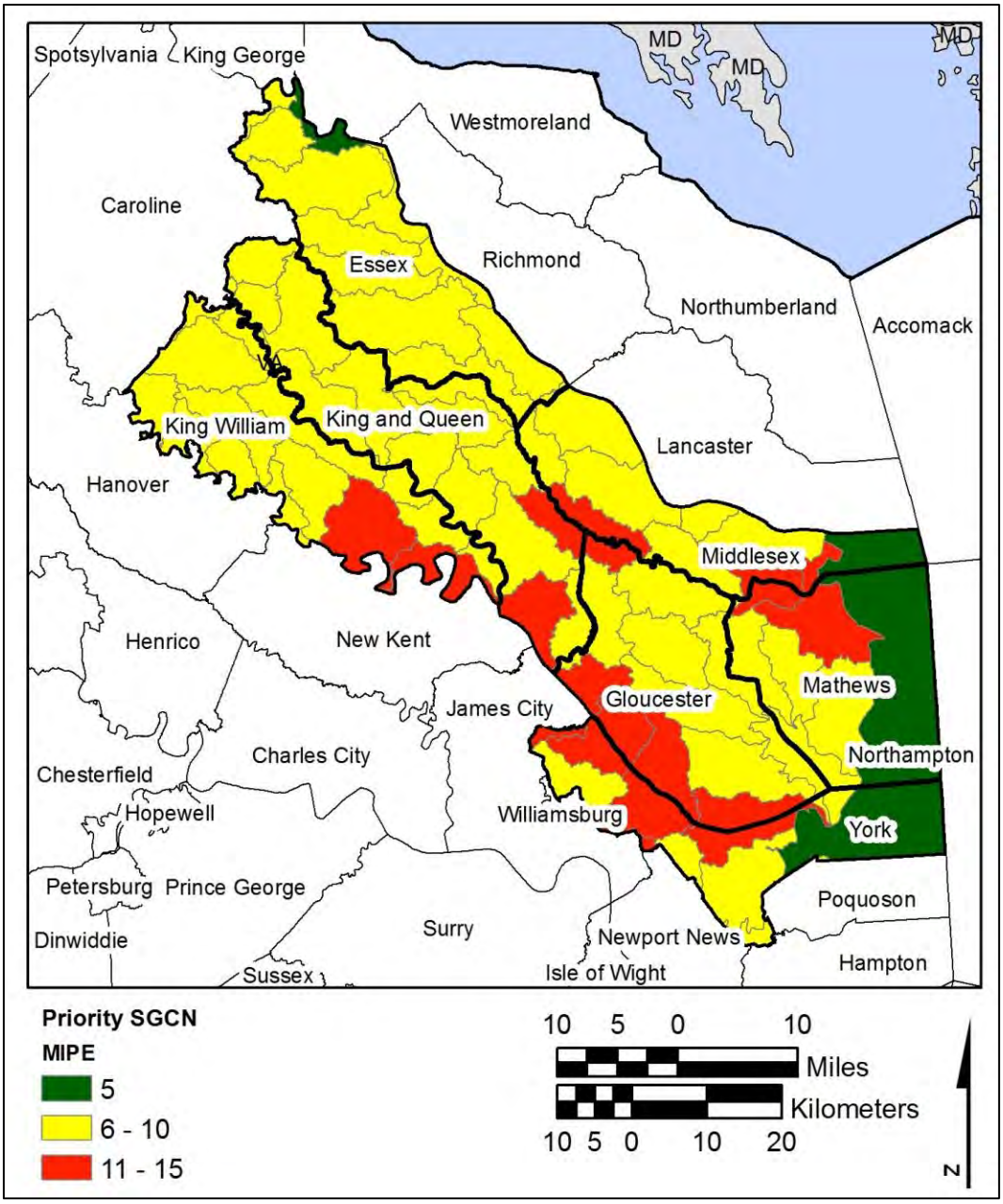

Figure 3. Priority SGCN Density in the Middle Peninsula Planning Region (HUC12 Watersheds.

Table 2. Priority Species of Greatest Conservation Need Distribution within the Middle Peninsula Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*	Freshwater wetlands with sphagnum moss
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*	Freshwater wetlands with sphagnum moss
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*	Forest and upland habitat generalist but require soils suitable for digging
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*	Pine and hardwood forests with vernal ponds and other water sources suitable for breeding
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water (AOU 1983). Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	b	Clapper rail	*Rallus longirostris*	Saltmarshes
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.

Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association.
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerow
Bird		III	a	Forster's tern	*Sterna forsteri*	Breeds in marshes with lagoon system
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird		II	b	King rail	*Rallus elegans*	Variety of fresh water and marine marshes and wetlands
Bird		III	b	Least bittern	*Ixobrychus exilis*	Freshwater marshes
Bird		IV	b	Marsh wren	*Cistothorus palustris*	Freshwater marshes with cattails and reeds
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*	Wintertime resident of maritime wetlands
Bird		III	a	Northern Bobwhite	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*	Grassy salt marshes
Bird		IV	b	Virginia rail	*Rallus limicola*	Fresh and brackish marshes, may visit salt marsh in winter
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west

Crustacean		I	c	Lancaster County amphipod	*Crangonyx baculispina*	Site specific - non-karst subterranean - requires clean groundwater
Fish		IV	a	Alewife	*Alosa pseudoharengus*	Migratory
Fish		IV	a	American shad	*Alosa sapidissima*	Large unfragmented migratory rivers for spawning
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory and utilize variety of aquatic and marine habitats
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*	Blackwater swamps, ponds, and streams with thick vegetation
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*	Warm small streams with slow flows and sand/silt substrates
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*	Migratory and utilize variety of aquatic and marine habitats
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*	Small streams to rivers with swift flow and sandy substrates
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*	Clean water with slow currents and sandy substrates, most often found in rivers with stable shorelines and wide riparian forests
FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*	No specific habitats have been identified for this aquatic snail but it occurs across most of North America
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	Beach obligate - does not tolerate heavy foot or vehicle traffic
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*	Freshwater and brackish marsh
Reptile		I	b	Green sea turtle	*Chelonia mydas*	Marine
Reptile		I	a	Kemp's ridley sea turtle	*Lepidochelys kempii*	Marine
Reptile		I	a	Leatherback sea turtle	*Dermochelys coriacea*	Marine
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*	Nests on ocean-facing beaches and occurs in the lower Chesapeake Bay and inshore, nearshore and offshore coastal waters
Reptile		IV	c	Rainbow snake	*Farancia erytrogramma erytrogramma*	Riparian forest - eel obligate

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Middle Peninsula Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks and forests to National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Rappahannock River Valley National Wildlife Refuge,
- Dragon Run State Forest,
- Sandy Point State Forest,
- Middle Peninsula State Park,
- Bethel Beach Natural Area Preserve, and
- New Point Comfort Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

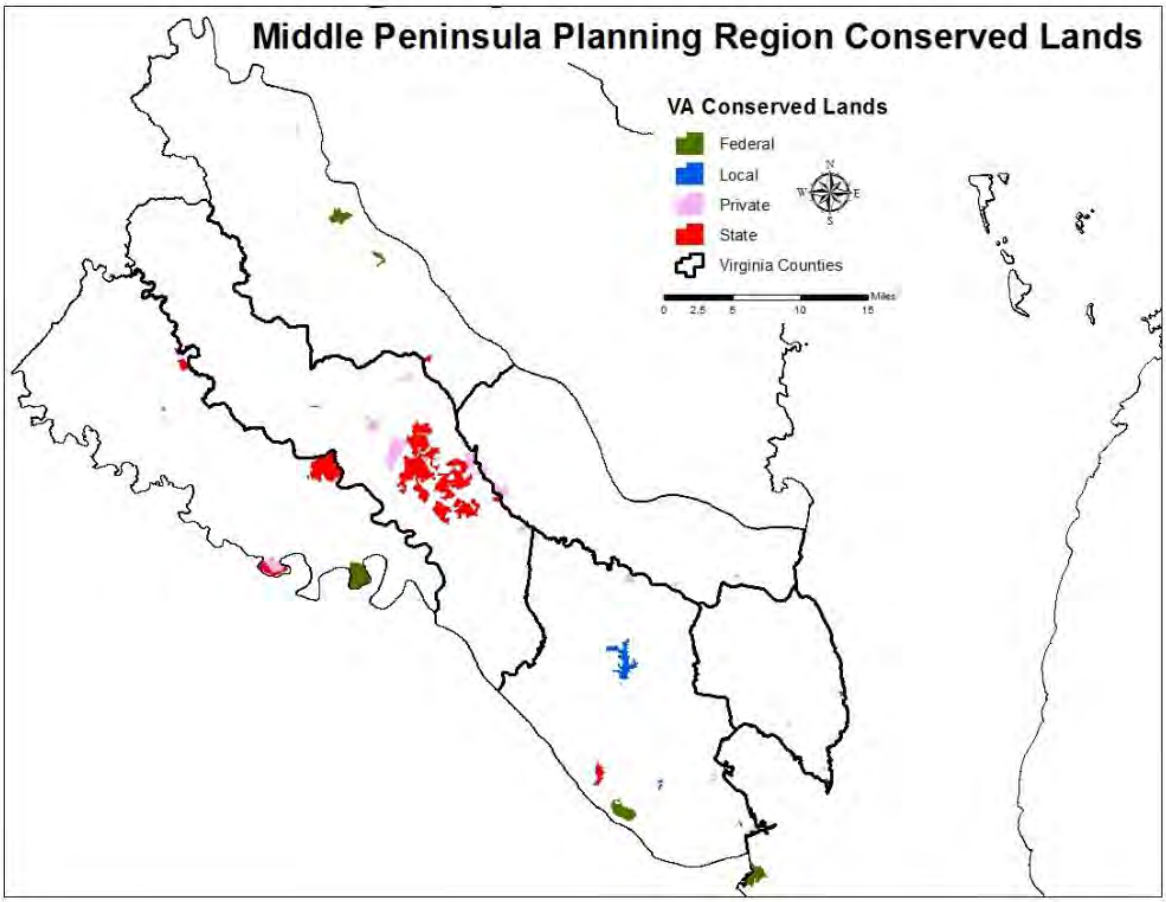

Figure 4. Conservation Lands in the Middle Peninsula Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Middle Peninsula Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to put more lands under protection could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits that benefit the local economy (DCR 2013a; Carver and Caudill 2013). For example, in 2014 the Rappahannock River Valley National Wildlife Refuge provided approximately $100,000 in economic benefit to the local economy through visitation expenditures and employment, and tax revenues (Pers. Comm. USFWS 2015). Using estimates from Carver and Caudill, the NWR also likely provides anywhere from $700,000 to $3 million in ecosystem service benefits to the community (2013).

Climate Change Impacts in Middle Peninsula Planning Region

Although the Middle Peninsula Planning Region has some areas further inland, much of the area is directly on Chesapeake Bay waters; thus, climate change and resulting sea-level rise and storm-related events may affect areas within the region. A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia. Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events are expected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are expected to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013). Gloucester and Mathews Counties have the lowest lying areas, and thus, are more susceptible to impacts from climate change impacts. The report also estimates, given climate projections, it is likely that 55 square miles of coastline will be vulnerable to sea-level rise (King William, Gloucester, and Mathews counties) (VIMS 2013).

Changes in temperature and precipitation will also negatively affect habitats and SCGN in the Middle Peninsula Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other

phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Habitats and Wildlife in the Middle Peninsula Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Middle Peninsula Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Middle Peninsula Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and conserve beach, dune, and mudflat habitats	1) Protect unconserved beach lands that support the Northeastern beach tiger beetle, least terns, and American oystercatchers; and 2) Identify priority areas for conservation, acquisition, and restoration.	Land conversion/ alteration, predators, climate change	Enhanced recreational opportunities; promote economic activity related to wildlife watching	Specific areas suitable for Northeastern beach tiger beetle or areas adjacent to habitats used by these species
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, climate change, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish riparian vegetative buffers along waterways; 2) Establish waste storage facilities; 3) Establish retention ponds, impoundments, or other features to manage and slow urban storm water runoff; 4) Work with landowners to implement small acreage grazing systems; 5) Repair or replace failing septic systems and pit privies; 6) Improve marina boat waste discharge facilities; 7) Work to prevent pet and kennel waste from entering waterways; 8) Continue to identify impaired waters in the planning region; and 9) Monitor and address invasive species impacts.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, water withdrawals, land use conversion, invasive species, overfishing, and climate change	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Barn Creek, Cobbs Creek, Edwards Creek, Healy Creek, Queens Creek, Stutts Creek, Upper Piankatank River, and Wilton River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, non-native exotic invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

Maintain and restore open habitats	1) Restore of native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Glades and barrens not already protected

Maintain and Conserve Beach, Dune, and Mud Flat Habitats

The Middle Peninsula Planning Region has extensive beach habitats that provide nesting habitat for the Northeastern tiger beetle, Wilson's plover, and piping plover. Beach, dune, and mud flat habitat make up approximately 450 acres (0.05 percent) of the planning region (Anderson et al. 2013).

Threats

Although some of the planning region's beach, dune, and mudflat habitats are protected by state and federal agencies, significant threats still exist.

1. Habitat Conversion/ Alteration: Beach, dune, and mudflat habitat in this planning region is primarily threatened by residential development. The accompanying infrastructure being built up against the dunes and beaches can destroy or alter fragile habitats. Shoreline hardening is also an issue along beaches. Hardening prevents natural processes from occurring and can result in erosion, displacement of sediment, and loss of shoreline habitat.

2. Climate Change: Climate change, with resulting sea-level rise and more intense storm events, will likely lead to increased coastal flooding. The effects of flooding are further exacerbated by naturally occurring land subsidence. Severe storms as well as sea-level rise will also likely increase erosion and salt water intrusion along the coast into sensitive ecosystems.

Conservation Management Actions

Beaches, dunes, and mudflats are dynamic and have important habitat and economic value. Conservation actions will require the conservation community to work closely with agencies, landowners, municipalities, and elected officials to find a sustainable balance between conservation, human recreation, and economic development. Each of these entities has valid regional concerns that should be considered within the broader management context to accommodate the various interests. Local coordination, protection, and management of beaches that support the Northeastern tiger beetle and other SGCN could be pursued if not already implemented.

Climate-Smart Management Actions

Because beach, dune, and mudflat habitats in this planning region are extremely susceptible to sea-level rise and impacts from storms, the primary climate-smart actions to help protect beach systems include expanding coastal restoration and conservation strategies to include protecting and/ or providing habitat adjacent to and upland of these beaches. This strategy will help allow for potential inland migration of beaches. Protecting these areas can occur through acquisition or partnerships with landowners. Expanding monitoring along these areas to enable early detection and action as areas become increasingly affected by sea-level rise and storm events (Glick et al. 2008).

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Middle Peninsula Planning Region. In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes are the most common wetland type in this area (Table 4). Non-tidal wetlands provide valuable habitats for the eastern mud salamander, carpenter frog, and king rails while tidal wetlands are habitats for Forester's tern, marsh wren, clapper rail, rare skipper, and a variety of other species.

Table 4. Wetland Acreage in Middle Peninsula Planning Region (Anderson et al. 2013).

Wetland Type	Acres	Percent of Planning Region
Non-Tidal	86,792.32	9.31%
Tidal	44, 764. 47	4.80%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to tidal and non-tidal wetlands is conversion to other uses such as residential housing and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of tidal wetland habitat through damage or loss to wetland vegetation. Mute swans out-compete native species by consuming significant amounts of emergent and submerged aquatic vegetation (DGIF 2012). Mute swans can also destroy vegetation by uprooting it, thereby limiting the effectiveness of wetland restoration (DGIF 2012). Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites*, purple loosestrife, Japanese stilt grass, and exotic invertebrates.

4. Climate Change: As sea levels rise, marshes can be inundated and convert to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open

water habitats and salt marshes will not support the same vegetative composition as the non-tidal and tidal wetlands in this planning region, affecting the wildlife species that depended on these habitats (CCSP 2009). Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Middle Peninsula Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option to for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Potection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Middle Peninsula Planning Region include those wetlands that are inland of tidal wetlands that may provide some opportunity for inland migration as sea levels rise. These more inland areas also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014).Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved

lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). Some of the highest priority wetland conservation opportunities exist adjacent to already protected lands in between King and Queen and Middlesex counties, adjacent to conserved lands between King William and King and Queen, and adjacent to conserved lands in Gloucester County. Multiple high priority areas for restoration exist along the Chesapeake Bay shoreline.

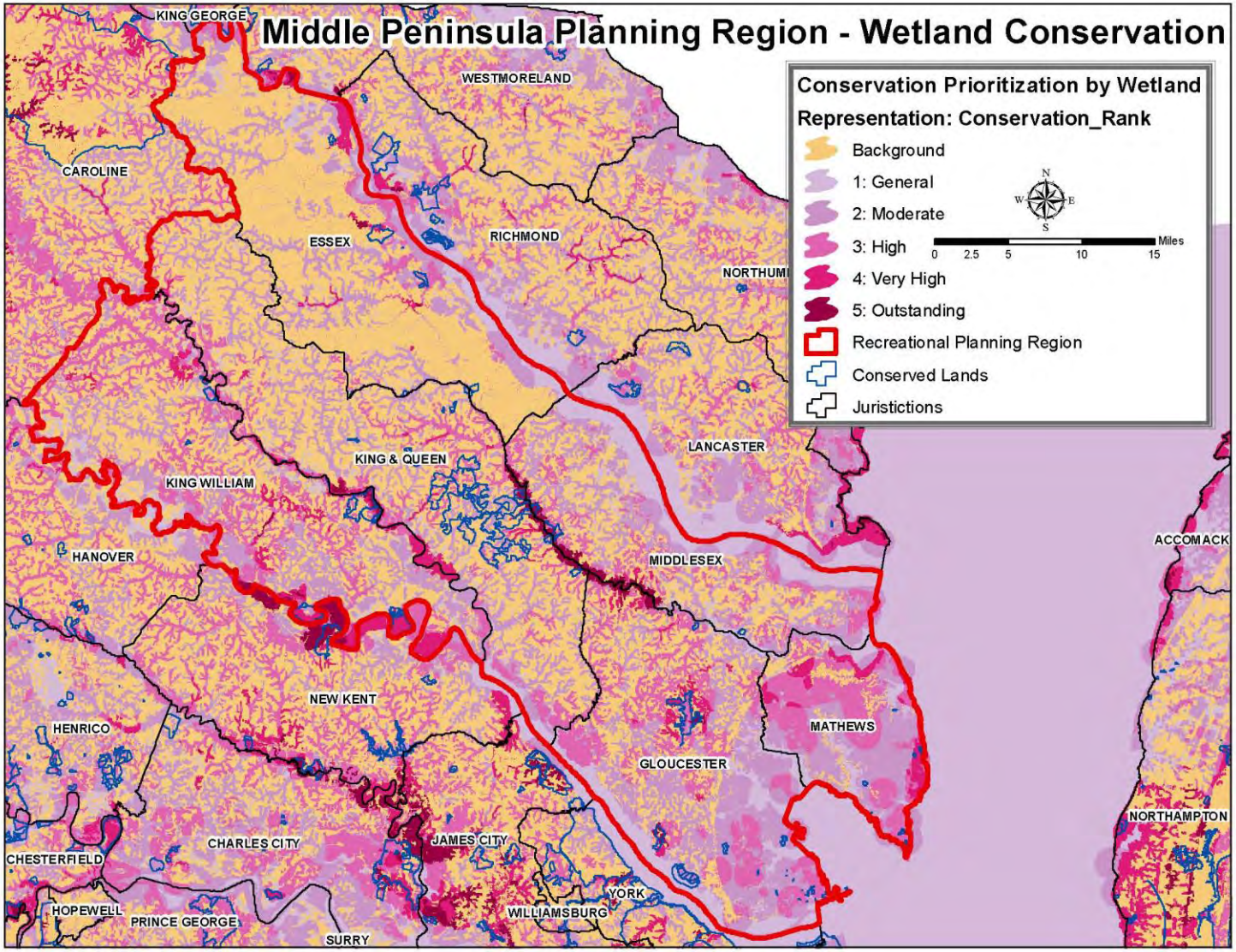

Figure 5. Wetlands Conservation Priority Areas in Middle Peninsula Planning Region (Weber and Bulluck 2014).

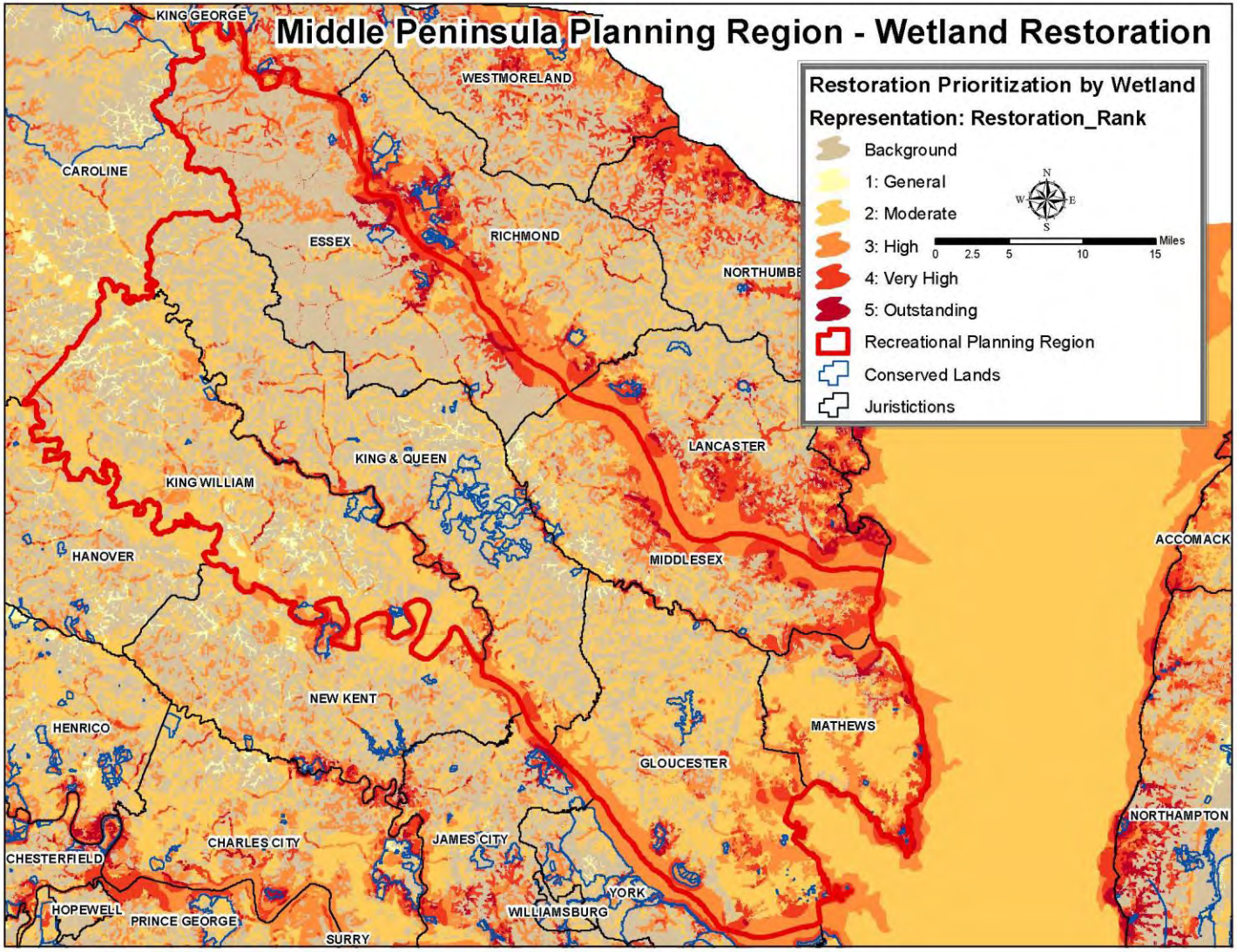

Figure 6. Wetland Restoration Priority Areas in Middle Peninsula Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Middle Peninsula Planning Region include tidally influenced and non-tidal freshwater creeks and streams. River systems include the Rappahannock, York, Pamunkey, and Mattaponi Rivers as well as smaller streams and creeks. Approximately 113,400 acres (12.2 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these aquatic systems include Atlantic and shortnose sturgeons, American shad, least brook lamprey, alewife floater, Carolina slabshell mussel, and ridged lioplax snail.

Threats

Aquatic and riparian habitats within the Middle Peninsula Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Middle Peninsula Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology,

or material inputs. The Middle Peninsula Planning Region has a low percentage of impervious surface cover; however, there are some with impervious surfaces (Figure 7).

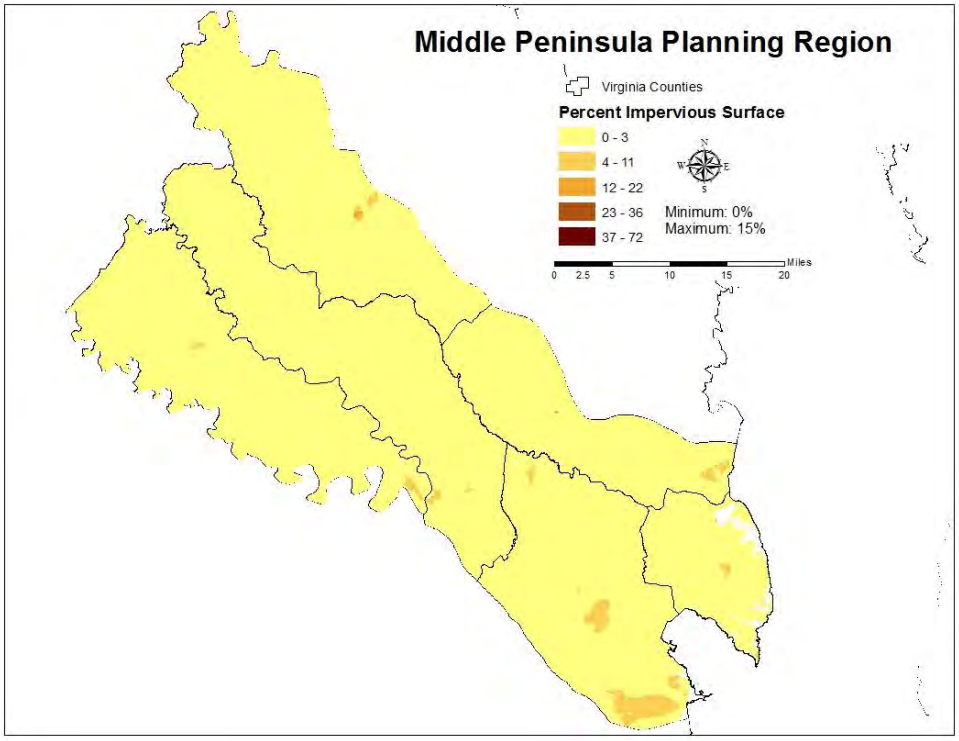

Figure 7. Impervious Surface Cover in Middle Peninsula Planning Region (SARP 2014).

3. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the aquifer that could degrade the quality of both subterranean and surface water.

4. Invasive Species: Additional threats to aquatic systems within Middle Peninsula Planning Region include invasive species such as blue catfish, snakeheads, Asian carp (e.g., big head carp and grass carp) that either consume native species or aquatic vegetation altering the quality of these aquatic habitats and invasive species impair waterways.

5. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Sea-level rise could result in inundation of shoreline, while changes in temperature and

precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Barn Creek, Cobbs Creek, Edwards Creek, Healy Creek, Queens Creek, Stutts Creek, Upper Piankatank River, and Wilton River (DCR 2013b) (Figure 8).

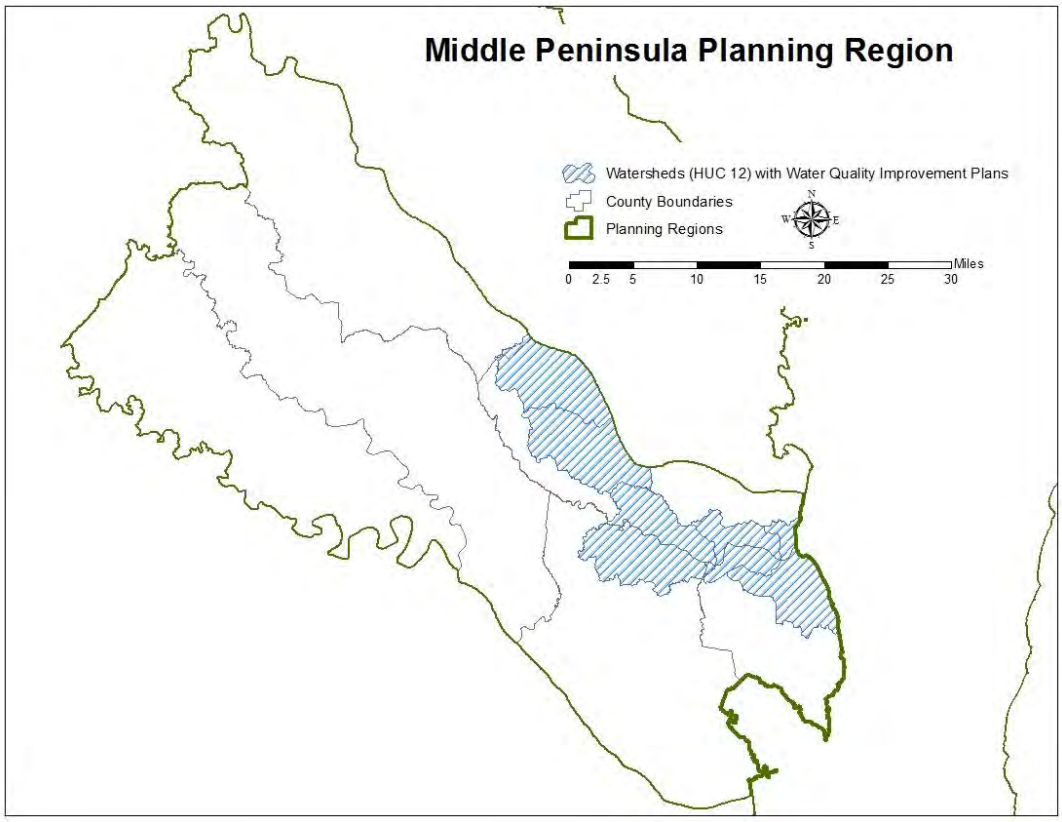

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality in these watersheds include:

- Establishing riparian vegetative buffers along waterways;
- Establishing waste storage facilities (such as dairy lagoons or waste sheds) to better manage animal waste and prevent flow into the river;
- Establishing retention ponds, impoundments, or other features to manage and slow storm water runoff from cropland, pastures, forests, and barren lands;
- Working with landowners to implement small acreage grazing systems;
- Repairing or replacing failing septic systems and pit privies;

- Improving marina boat waste discharge facilities; and
- Working to prevent pet and kennel waste from entering waterways and establishing a pet litter program to encourage owners to clean up pet waste.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

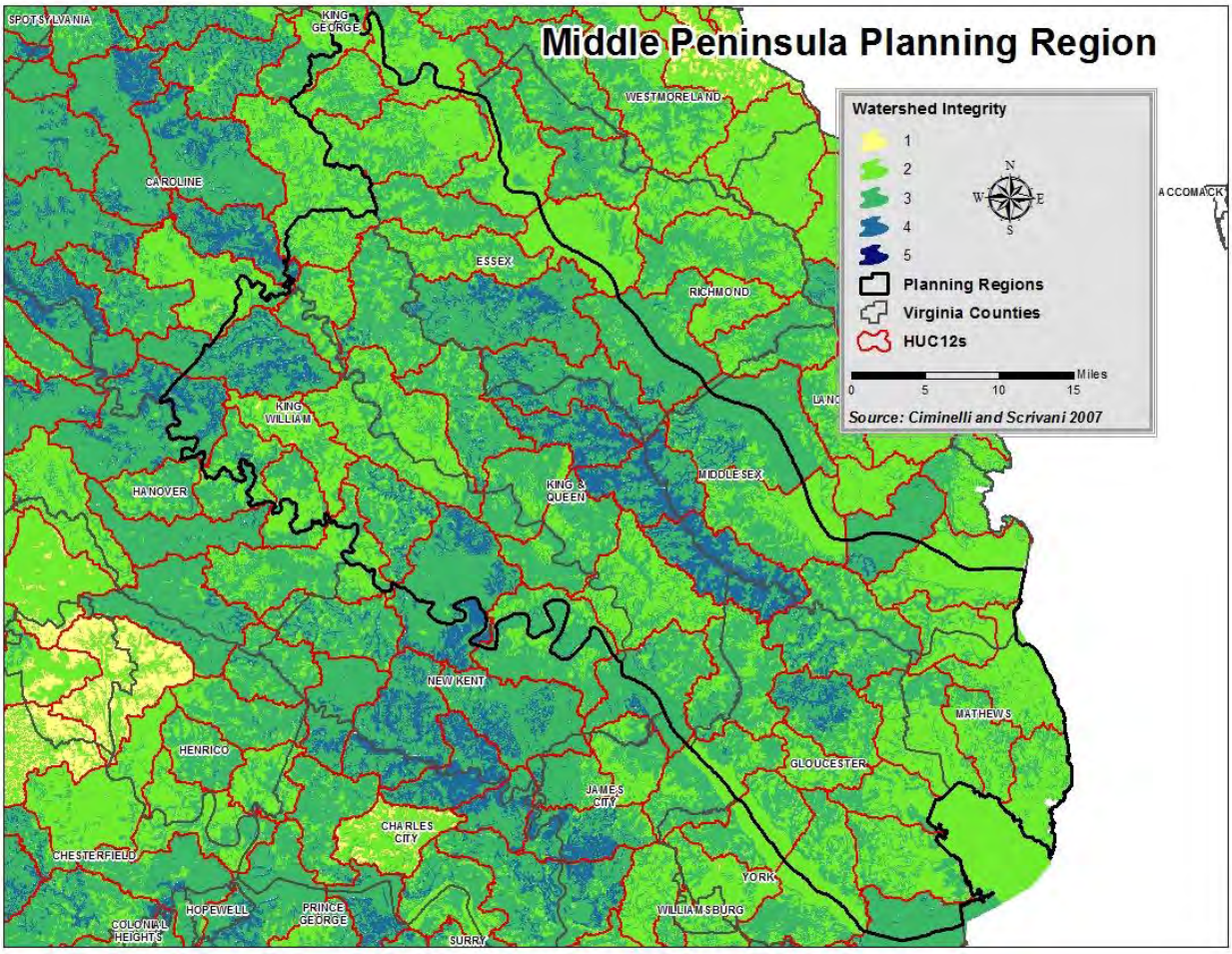

Figure 9. Watershed Integrity Model for Middle Peninsula Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Middle Peninsula Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

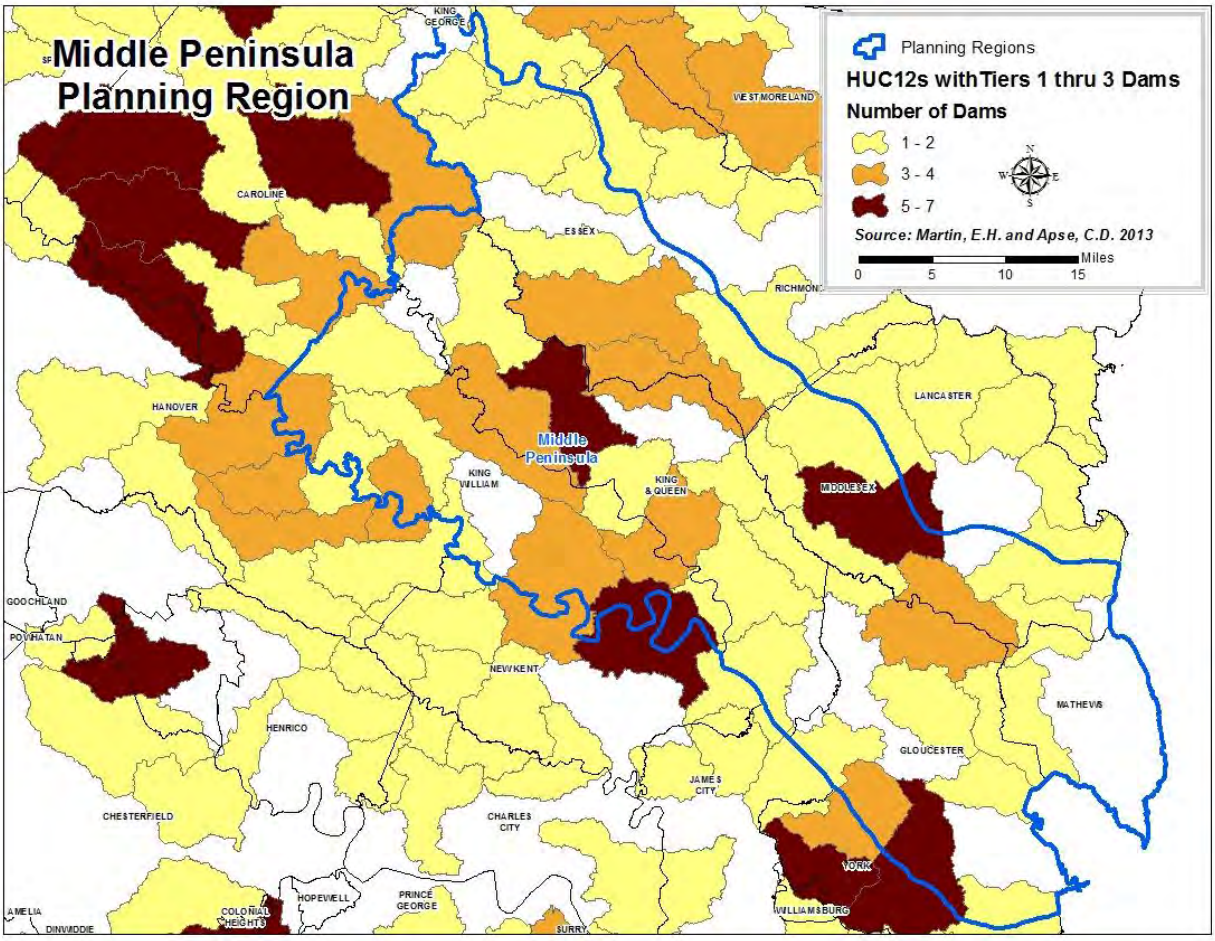

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Middle Peninsula Planning Region include: monitoring and addressing invasive species impacts as well as promoting efforts to rinse boats and trailers on site and considering land acquisitions or easements that will help protect the land surrounding creeks.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Because sea-level rise will likely be an issue, tree and shrub species that have a broader salinity tolerance should be considered. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost half of Middle Peninsula Planning Region and are important for a broad range of species (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as Mabee's salamander, Eastern spadefoot, Eastern whip-poor-will, and Kentucky warbler.

Table 5. Forest Acreage Totals in Middle Peninsula Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	438,958.91	47.09%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Middle Peninsula Planning Region is fragmentation, mainly due to residential development and resulting roads and infrastructure. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine

plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species such as privet and Japanese stilt grass and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Middle Peninsula Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

Several agencies, including DGIF, NRCS, DOF, USFWS, and the U.S. Forest Service (USFS) advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Climate-Smart Management Actions

To best manage forests in the Middle Peninsula Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for action plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens. These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. Within this planning region, glades and barrens are the primary open habitat present. These areas provide habitat for the golden winged warbler, loggerhead shrike, and the Persius duskywing.

Threats

Changing land use patterns has played a large role in the loss of open forests habitats as has the alteration of natural disturbance regimes.

1. Land Use Changes: Dozens of open and young forest species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, Chinese lespedeza, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas has caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Essex County, King and Queen County, and King William County offer some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011,

the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Middle Peninsula Planning Region, priority conservation opportunities include:

- Protecting beaches, dunes, and mud flats;
- Protecting and restoring tidal and non-tidal wetlands;
- Improving the quantity and quality of water in creeks and rivers through best management practices and water quality improvement mechanisms;
- Maintaining and restoring open habitats, and
- Conserving tracts of mature hardwood and conifer forests.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN MIDDLE PENINSULA PLANNING REGION

Complete SGCN list for the Middle Peninsula Planning Region (SGCN=100). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian	**ST**	II	a	Barking treefrog	*Hyla gratiosa*
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*
Bird		III	a	Brant	*Branta bernicla*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American oystercatcher	*Haematopus palliatus*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	b	Clapper rail	*Rallus longirostris*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*

Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		II	b	King rail	*Rallus elegans*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Least tern	*Sterna antillarum*
Bird		IV	a	Marbled godwit	*Limosa fedoa*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		IV	c	Purple sandpiper	*Calidris maritima*
Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		III	a	Saltmarsh sparrow	*Ammodramus caudacutus*
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean		I	c	Lancaster County amphipod	*Crangonyx baculispina*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		IV	c	Banded sunfish	*Enneacanthus obesus*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*

Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*
FW Mollusk		IV	c	Sharp sprite	*Promenetus exacuous*
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		I	b	Green sea Turtle	*Chelonia mydas*
Reptile		I	a	Kemp's Ridley sea turtle	*Lepidochelys kempii*
Reptile		I	a	Leatherback sea Turtle	*Dermochelys coriacea*
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

14. Mount Rogers Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife and Conservation Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and are found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

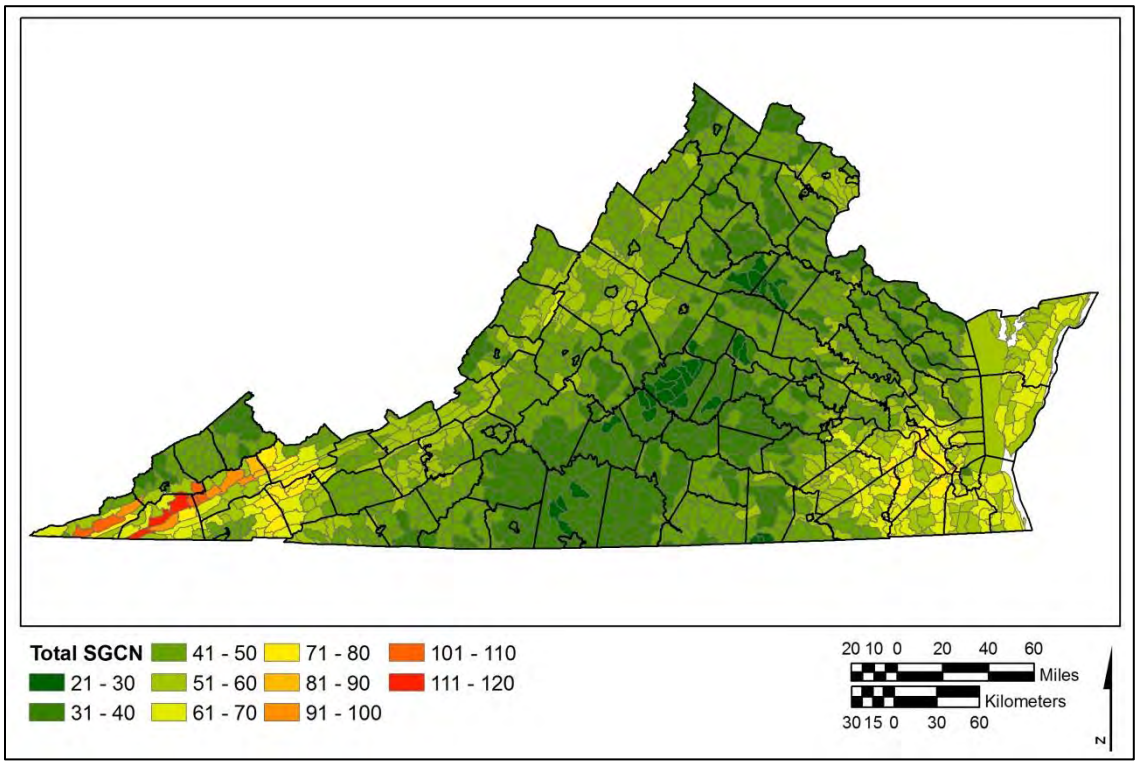

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

MOUNT ROGERS PLANNING REGION SUMMARY OVERVIEW

The Mount Rogers Planning Region consists of 1,782,255 acres (2,785 square miles) and includes the counties of Bland, Carroll, Grayson, Smyth, Washington, and Wythe as well as the cities of Bristol and Galax. The human population in this planning region is estimated to be almost 191,000 people (U.S. Census Bureau 2015). Although these populations are projected to increase by 2020, the growth rate is less than two percent (DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, such as the greenfin darter, incurved cave isopod, purple Lilliput, fatlips minnow, Blue Ridge two-lined salamander, flat button snail, red crossbill, and Carolina northern flying squirrel. The planning region also includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

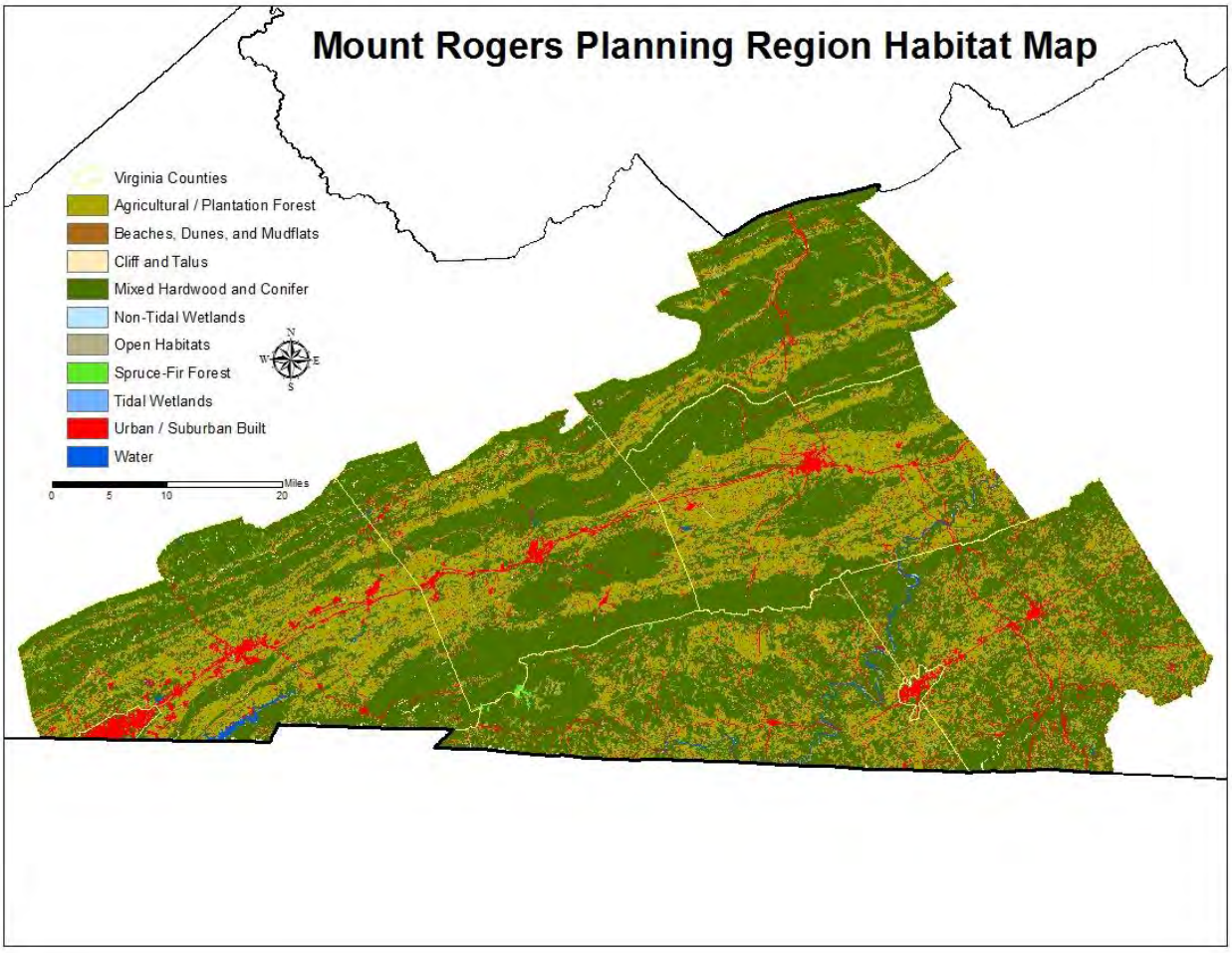

Figure 2. Mount Rogers Planning Region Land Cover (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 167 are believed to either occur, or have recently occurred, within the Mount Rogers Planning Region (Appendix A). Of these 168 species, ***147 SGCN are dependent upon habitats provided within the Mount Rogers Planning Region (Table 2).*** These species constitute the priority SGCN for the region. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 146 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also

included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	10
Ib	8
Ic	11
IIa	9
IIb	2
IIc	22
IIIa	12
IIIb	5
IIIc	17
IVa	17
IVb	7
IVc	27

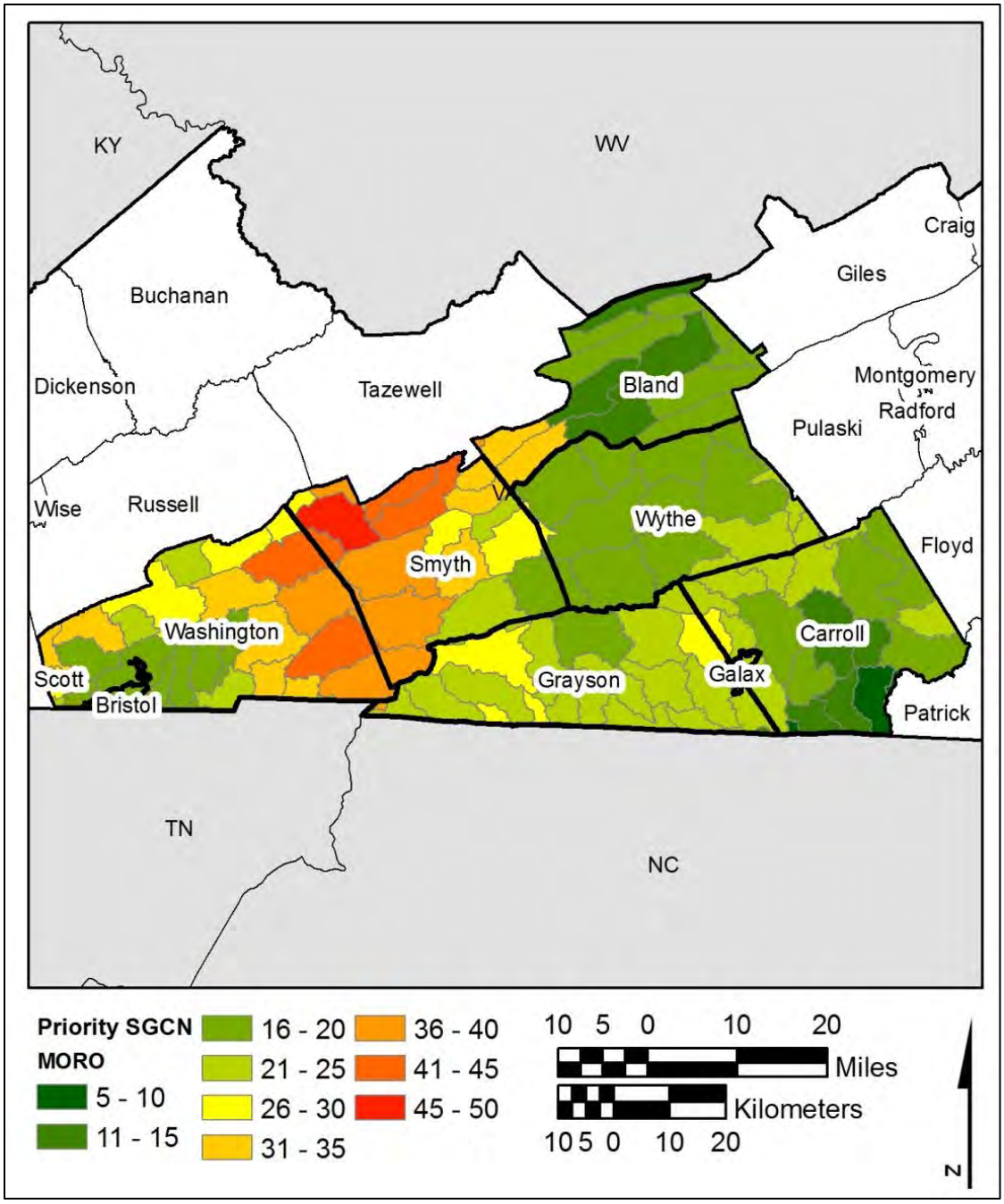

Figure 3. Priority SGCN Density in the Mount Rogers Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution the Mount Rogers Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*	High elevation seeps, streams, wet rock faces, and riparian forests
Amphibian		III	a	Blue Ridge two-lined salamander	*Eurycea wilderae*	Mountain streams and adjacent riparian areas with mixed hardwood or spruce-fir forests up to 6000 feet
Amphibian		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*	Mature hardwood forests in the vicinity of rocky outcrops
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Clean streams and rivers with rocky substrates
Amphibian		II	b	Green salamander	*Aneides aeneus*	Damp, but not wet, crevices in shaded rock outcrops and ledges in forested areas
Amphibian		II	a	Mountain chorus frog	*Pseudacris brachyphona*	Forested areas up to 3500 feet that contain suitable breeding sites
Amphibian		III	c	Northern Pygmy salamander	*Desmognathus organi*	Forested habitats in proximity to seeps and springs
Amphibian		III	a	Shovel-nosed salamander	*Desmognathus marmoratus*	Cool highly oxygenated high elevation streams with moderate flow and gravel and rock substrates
Amphibian		II	c	Southern zigzag salamander	*Plethodon ventralis*	Hardwood forests in the vicinity of rocky outcrops
Amphibian		I	b	Weller's salamander	*Plethodon welleri*	Either moist cove hardwoods or spruce-fir forests above 2500 feet
Amphibian		IV	c	Yonahlossee salamander	*Plethodon yonahlossee*	Mature hardwood forests with deep leaf litter layer
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		IIi	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.

Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*	Open shrubby habitat (e.g., old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		III	a	Northern bobwhite quail	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests

Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River
Bird		III	c	Red crossbill	*Loxia curvirostra*	Spruce-fir or hemlock forests above 4000 feet
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FS**	II	c	Incurved Cave isopod	*Caecidotea incurva*	Caves with clean abundant water flowing through the system.
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*	Blue Ridge to the west - cliffs dry rocky slopes, talus, and exposed ridges
Crustacean		III	c	Reticulate crayfish	*Orconectes erichsonianus*	Streams with rocky substrates
Crustacean		IV	c	Surgeon crayfish	*Orconectes forceps*	Streams with rocky substrates
Fish		IV	c	Appalachia darter	*Percina gymnocephala*	Clear, cool and warm streams in the New drainage with upland gradient and gravel substrates
Fish		IV	c	Black sculpin	*Cottus baileyi*	Cold creeks and streams with moderate to high gradient and clean gravel and boulder substrates
Fish		IV	c	Blackside darter	*Percina maculata*	Clean streams and rivers with moderate gradient and various substrates
Fish		IV	c	Blotched chub	*Erimystax insignis*	Clean, cool to warm, streams and rivers with moderate gradient and clean gravel and rubble substrates
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*	Clear warm streams and rivers with moderate gradient with silt free gravel, rubble, or boulder substrates
Fish	**FS**	III	c	Bluestone sculpin	*Cottus sp. 1*	Cool or cold limestone spring runs with strong flows and gravel or rubble substrates and aquatic vegetation
Fish		IV	c	Brook silverside	*Labidesthes sicculus*	Clear cool or warm lakes and large rivers and can tolerate various substrates and various amounts of aquatic vegetation
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*	Clear creeks and streams with rocky substrates

Fish		III	c	Common mudpuppy	*Necturus maculosus maculosus*	Permanent lakes, ponds, impoundments, streams, and rivers with suitable hiding cover
Fish		II	c	Fatlips minnow	*Phenacobius crassilabrum*	Clear moderate to high gradient streams and rivers with clean gravel, rubble, and boulder substrates
Fish	**ST**	I	b	Greenfin darter	*Etheostoma chlorobranchium*	Clear high gradient streams with rocky substrates
Fish		IV	c	Highback chub	*Hybopsis hypsinotus*	Warm water (either clear or turbid) with sandy or rocky bottoms.
Fish	**FS**	III	c	Holston sculpin	*Cottus sp. 5*	Clear streams with moderate to high gradient and clean gravel, rubble, or boulder substrates
Fish		III	c	Kanawha darter	*Etheostoma kanawhae*	Clear creeks and streams with rocky substrates
Fish		III	c	Kanawha minnow	*Phenacobius teretulus*	Clear moderate gradient streams with clean gravel and rubble substrates
Fish		IV	c	Logperch	*Percina caprodes*	Warm, moderate gradient, streams and rivers with gravel and rubble substrates
Fish		III	c	Mirror shiner	*Notropis spectrunculus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*	Cool creeks or streams with moderate flow and clean substrates with access to pool sediments and muddy banks for ammocoetes
Fish		IV	c	Mountain shiner	*Lythrurus lirus*	Typically in clear, flowing, riffle-pool type creeks and small rivers with moderate gradients and bottom materials ranging from sand- gravel to rubble-boulder
Fish		IV	c	New River shiner	*Notropis scabriceps*	Small to large, cool water, tributaries of the New River with high to moderate gradient and unsilted substrates
Fish		IV	c	Northern studfish	*Fundulus catenatus*	Cutoff pools, backwaters, and sluggish margins of clear, warm, moderate gradient creeks, streams and rivers with a variety of substrates
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*	Large warm rivers with clean gravel and rubble substrates and access to low gradient areas with soft substrates and detrital material for ammocoetes
Fish		IV	c	Piedmont darter	*Percina crassa*	Cool and warm moderate gradient creeks and rivers with clean gravel and rubble substrates
Fish		II	c	Popeye shiner	*Notropis ariommus*	Clear warm moderate gradient rivers with gravel or rubble substrates
Fish		IV	c	Redlip shiner	*Notropis chiliticus*	Clear creeks and streams with moderate gradient, warm or cool water and various substrates
Fish		III	b	River redhorse	*Moxostoma carinatum*	Clean streams and rivers with unsilted gravel, rubble, and boulder substrates
Fish		III	c	Rustyside sucker	*Thoburnia hamiltoni*	Clean clear streams with moderate to high gradient and unsilted substrates
Fish	**SE**	I	c	Sharphead darter	*Etheostoma acuticeps*	Clear, cool, or warm streams and rivers with moderate gradient and rubble and boulder substrates with growths of riverweed
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*	Moderate gradient streams and rivers with unsilted gravel, rubble, and boulder substrates
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*	Clean medium sized streams and rivers with clean gravel and cobble substrate

Fish		IV	c	Stonecat	*Noturus flavus*	Warm streams and rivers with moderate to low gradient with rocky substrates
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*	Cool clear streams with moderate to high gradient with clean gravel, rubble, and boulder substrates
Fish		IV	c	Tangerine darter	*Percina aurantiaca*	Clean, cool and warm streams and rivers with moderate gradient and a variety of substrates
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*	Clean creeks with rock, gravel, or silt substrates and stable banks
Fish		III	c	Wounded darter	*Etheostoma vulneratum*	Warm moderate gradient streams and rivers with clean gravel and rubble substrate
FW Mollusk	**ST**	III	a	Black sandshell	*Ligumia recta*	Medium to large rivers with strong currents and sand, gravel, and cobble substrates
FW Mollusk		III	c	Brown walker	*Pomatiopsis cincinnatiensis*	Amphibious - vegetated banks of streams, creeks, and rivers
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk		IV	a	Cumberland moccasinshell	*Medionidus conradicus*	Small headwater streams with sand and gravel substrates and extends well into medium sized rivers
FW Mollusk		II	c	Elktoe	*Alasmidonta marginata*	Small shallow rivers with moderately fast current and sand and gravel substrates
FW Mollusk	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*	Clear high gradient streams in unsilted gravel and cobble substrates
FW Mollusk	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*	Small to medium rivers with swift current and sand, gravel, or cobble substrates
FW Mollusk		I	a	Golden riffleshell	*Epioblasma florentina aureola*	Aquatic
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*	Clean, calm water in streams and rivers of various sizes with sand and gravel substrates
FW Mollusk	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*	High gradient headwater streams
FW Mollusk		III	a	Longsolid	*Fusconaia subrotunda*	Medium to large rivers with strong currents and sand and gravel substrates
FW Mollusk		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*	Very clean small headwaters creeks and streams with sand and gravel substrates and associated with *Justicia* beds
FW Mollusk		III	b	Pink heelsplitter	*Potamilus alatus*	On a variety of substrates in slow to swiftly flowing water
FW Mollusk	**ST**	III	b	Pistolgrip	*Tritogonia verrucosa*	Large rivers with gravel, sand, or mud substrates
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk	**FSSE**	II	c	Purple liliput	*Toxolasma lividus*	Small to medium sized streams in well packed sand or gravel substrates

FW Mollusk	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*	Warm medium to large rivers with swift currents and silt, sand, gravel, or cobble substrates
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*	If this species is consistent with other species in this genus, clean mid-sized rivers with fast flows and rocky substrates
FW Mollusk	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*	Moderate to swift current with stable sand, gravel, or cobble substrates
FW Mollusk	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*	Large creeks to moderate rivers with moderate flow and gravel and sand substrates
FW Mollusk	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*	Headwater creeks and small streams with constant flow and mud, sand, or gravel substrates and aquatic vegetation
FW Mollusk	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*	Small to medium sized creeks with swift current and sand, gravel, and cobble substrates
FW Mollusk	**FSST**	III	a	Spiny riversnail	*Io fluvialis*	Large rocks and bedrock outcrops in well-oxygenated shallow water with fast current.
FW Mollusk		III	a	Tennessee clubshell	*Pleurobema oviforme*	Creeks and small rivers with moderate flow and sand/ gravel substrates
FW Mollusk	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*	Small headwater streams with sand or mud substrates
FW Mollusk	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*	Headwater streams to rivers with moderate to high flow and unsilted gravel/ sand rubble, or boulder substrates
FW Mollusk		IV	c	Three-ridge valvata	*Valvata tricarinata*	Unknown habitat needs in Virginia but in other parts of the country this species is associated with aquatic vegetation
Insect	**FS**	I	a	Big stripetail stonefly	*Isoperla major*	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect	**FSSE**	I	c	Buffalo Mountain mealybug	*Puto kosztarabi*	South slope of Buffalo Mountain in Floyd county on poverty oatgrass in open glades
Insect	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*	Small shady spring fed streams with mud bottoms
Insect	**FS**	I	c	Cryptic willowfly	*Taeniopteryx nelsoni*	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*	Large rivers with rocks and moderate current
Insect	**FS**	II	c	Maiden Spring cave beetle	*Pseudanophthalmus virginicus*	Caves with clean abundant water flowing through the system
Insect		II	c	Pygmy snaketail	*Ophiogomphus howei*	Large fast flowing rivers
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*	Glades and prairie remnants
Insect	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*	Caves with clean abundant water flowing thru the system
Insect	**FS**	II	c	Vicariant cave beetle	*Pseudanophthalmus vicarius*	Caves with clean abundant water flowing through the system

Mammal		IV	c	Allegheny woodrat	*Neotoma magister*	Blue Ridge to the west - riparian areas, wooded wetlands, caves and cliffs
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*	High elevation forested areas west of the Shenandoah river
Mammal	**FESE**	I	c	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	Cool moist mature coniferous and mixed forests with abundant standing and down snags
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred, though sometimes deeper locations are used. Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*	Blue Ridge to the west - rock piles, rock slides and cliffs surrounded by forests
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*	Caves typically in limestone karst regions dominated by mature hardwood forests of hickory, beech, maple, and hemlock. Prefers cool, well-ventilated caves for hibernation; roost sites are often near cave entrances or in places where there is considerable air movement.
Other Aquatic Invertebrate	**FS**	II	c	A cave lumbriculid worm	*Spelaedrilus multiporus*	Caves with clean abundant water flowing through the system
Other Aquatic Invertebrate	**FS**	I	c	A cave lumbriculid worm	*Stylodrilus beattiei*	Caves with clean abundant water flowing through the system
Other Aquatic Invertebrate	**FS**	I	c	Chandler's planarian	*Sphalloplana chandleri*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius regulus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia momus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia armesi*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Big Cedar Creek millipede	*Brachoria falcifera*	No habitats have been identified for this species

Other Terrestrial Invertebrate		III	c	Flat button	*Mesomphix subplanus*	Forested areas above 2000 feet with downed logs and moist leaf litter
Other Terrestrial Invertebrate	**FSST**	I	c	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*	Known from one location where it occurs under leaf litter of rhododendrons and hardwoods within 5 meters of stream
Other Terrestrial Invertebrate	**FS**	II	c	Montane centipede	*Escaryus cryptorobius*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*	Known from four locations and occupies leaf litter at the base of limestone/shale outcropings.
Other Terrestrial Invertebrate	**FS**	II	c	Turner's millipede	*Brachoria turneri*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Whitetop Mountain centipede	*Escaryus orestes*	No habitats have been identified for this species
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*	Emergent wetlands with dense vegetation
Reptile		III	c	Cumberland slider	*Trachemys scripta troostii*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches
Reptile		III	c	Eastern black kingsnake	*Lampropeltis getula nigra*	This species is known to utilize various habitats including Dry rocky hills, open woods, dry prairies, stream valleys, and many other habitats
Reptile		IV	a	Northern map turtle	*Graptemys geographica*	Clear flowing water with gravel substrates
Reptile		IV	a	Spiny softshell	*Apalone spinifera spinifera*	Clean clear rivers with flowing water and sand substrates
Reptile		IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*	Warm streams with fast flows and rock and cobble substrates

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Mount Rogers Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. The conservation mechanisms range from national forests to state parks, wildlife management areas, and forests to conservation easements. Significant conservation assets, in terms of size, include:

- Jefferson National Forest,
- Mount Rogers National Recreation Area,
- The Big Survey Wildlife Management Area,
- Stewarts Creek Wildlife Management Area,
- Crooked Creek Wildlife Management Area,
- Hidden Valley Wildlife Management Area,
- Clinch Mountain Wildlife Management Area,
- Hungry Mother State Park,
- New River Trail State Park,
- Grayson Highlands State Park,
- Channels State Forest,
- Hawks State Forest,
- Matthews State Forest,
- Old Flat State Forest,
- Big Spring Bog State Natural Area Preserve,
- Grayson Glades State Natural Area Preserve,
- Red Rock Mountain State Natural Area Preserve, and
- The Channels State Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

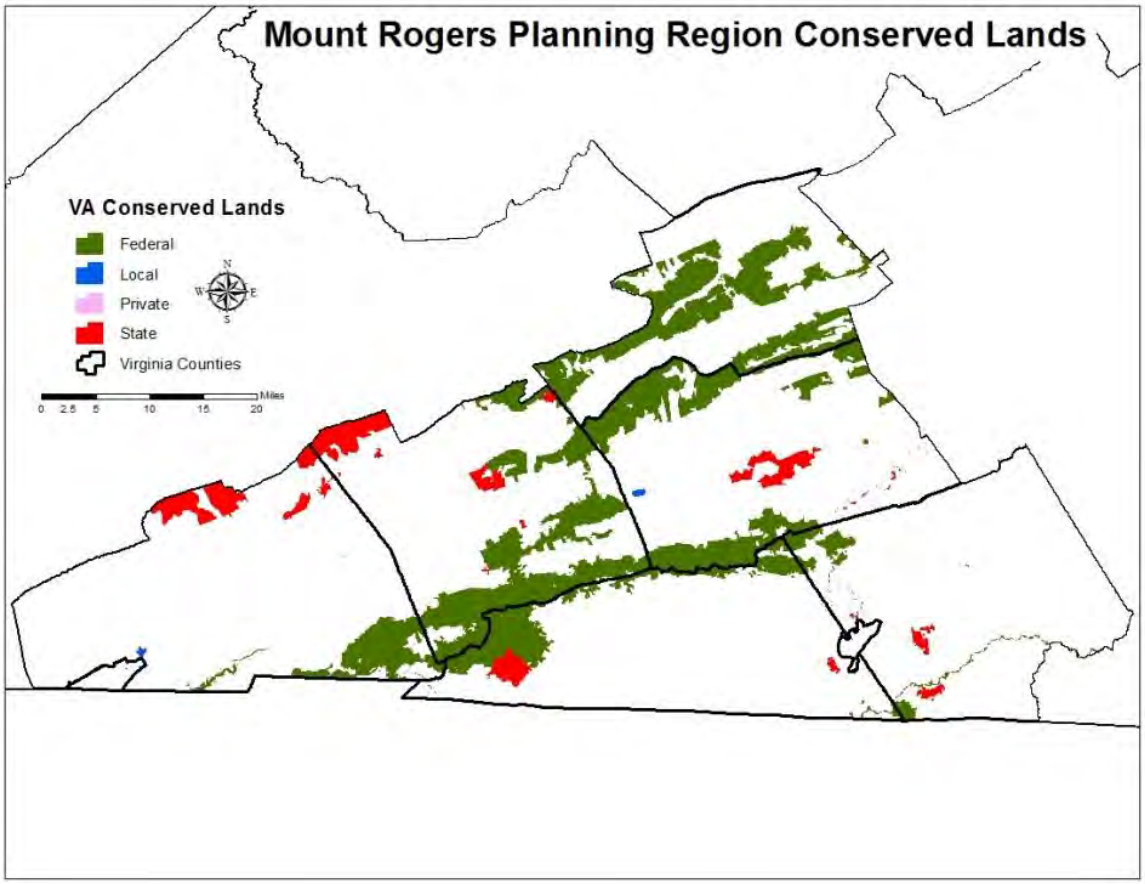

Figure 4. Conservation lands in the Mount Rogers Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Mount Rogers Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. There may be concern over the economic and social impacts of putting more lands into conservation, but many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Mount Rogers Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the Mount Rogers Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the Appalachians than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013).

Precipitation events are also likely to become more frequent, more intense, and more variable in the Appalachian region and thus within this Planning Region (Staudinger et al. 2015). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species' reproductive cycles and other phenological processes may be affected. Additionally, if temperatures and precipitation change such that season length is altered, fish and other species' reproductive cycles and other phenological processes may be affected. Other ecological conditions may also be affected, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the Mount Rogers Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Mount Rogers Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary Conservation Strategies and Actions for the Mount Rogers Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Commercial/ residential water consumption, sedimentation and pollutants, protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Exclude livestock from streams; 2) Establish or enhance vegetative and/ or forested buffers along streams and around sinkholes; 3) Improve pasture, loafing lot, and barnyard management to prevent manure-tainted water from flowing into streams; 4) Repair or replace failing septic systems and eliminating "straight pipes;" 5) Restore stream banks and establish vegetative buffers along streams; 6) Implement conservation tillage practices; 7) Establish rain gardens, bioretention filters, and retention ponds; 8) Establish retention ponds to treat tainted runoff; 9) Reforest highly erodible pasture lands; 10) Continue to identify impaired waters within the planning region; 11) Restore aquatic connections; 12) Monitor and address invasive species impacts; and 13) Adopt land use practices or policies	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Abrams Creek, Beaver Creek, Brumley Creek, Cove Creek, Laurel Creek, Lick Creek, Little Moccasin Creek, Locust Cove Creek, Logan Creek, Nordyke Creek, North Fork Holston River, Robertson Branch, Smith Creek, Toole Creek, Tumbling Creek, Turkey Run Creek, Wolf Creek, Little Creek, Cedar Creek, Halls Creek, Hutton Creek, Cripple Creek, Elk Creek, Middle Fork Holston River, Reed Creek

	through zoning or other means to help improve the health of aquatic systems.			
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore of native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Mount Rogers Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for many SGCN, including the incurved cave isopod, Hoffman's cave beetle, a cave mite, a cave springtail, and a wide variety other important species. Others species such as the Indiana bat depend on karst habitat and are endangered throughout their range. Caves in this planning region provide crucial winter habitat for some bat species.

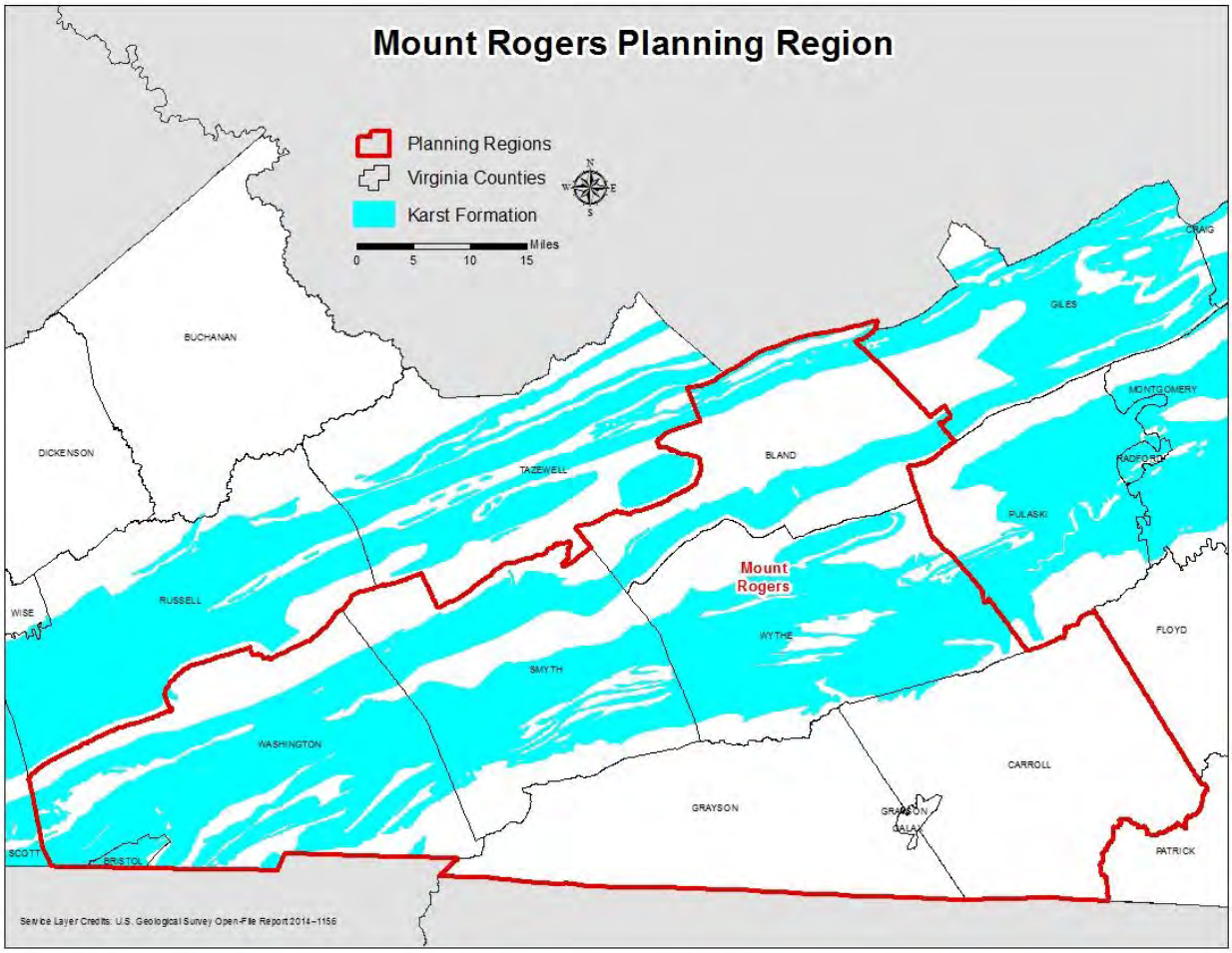

Figure 5. Karst Areas in the Mount Rogers Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems are affected

by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites as well as through development and resulting pollutant-laden runoff (DCR 2008).

2. Altered Hydrology: Development, which also likely plays a role in degraded water quality in the areas where karst systems occur, can also result in altered hydrology which can affect water quantity and flows. The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding

is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change. If precipitation and storm events become more intense, then there likely will be more stormwater runoff.

Maintain and Restore Wetland Habitats

A very small percentage of the Mount Rogers Planning Region is wetland habitat. Non-tidal wetlands make up approximately 0.17 percent (2,975 acres) of the planning region (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for the green heron and bog turtle, among other species.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When BMPs are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that result in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation. Examples of invasive species affecting these non-tidal wetlands include: purple loosestrife and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Mount Rogers Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Mount Rogers Planning Region include those wetlands allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 6) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). Most of the highest opportunities for conservation exist in Bland and Washington counties; however, all counties have some areas of highest priority. Highest priority areas for restoration are in greatest concentration in Washington, Smyth, and Carroll Counties.

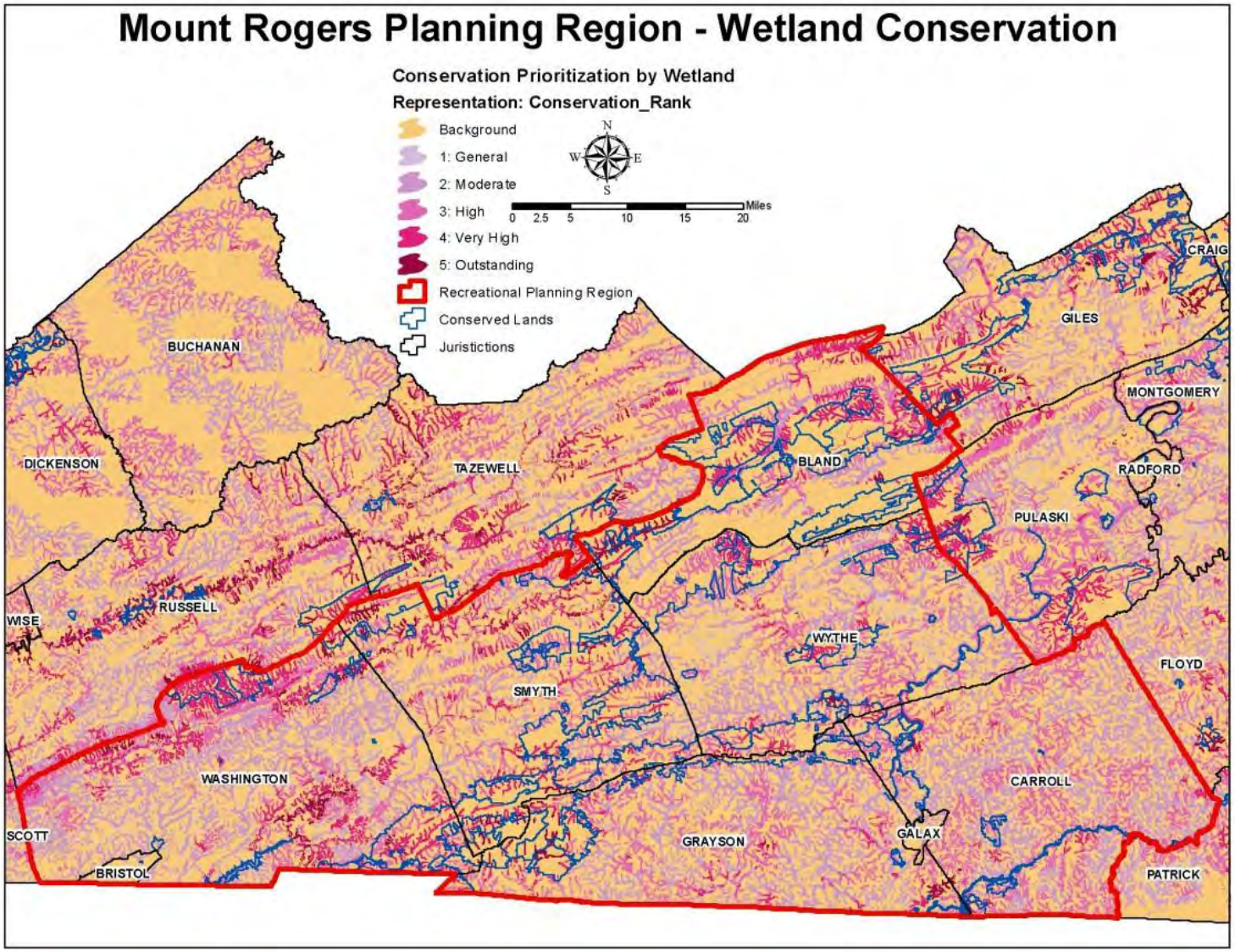

Figure 6. Wetland Conservation Priority Areas in Mount Rogers Planning Region (Weber and Bulluck 2014).

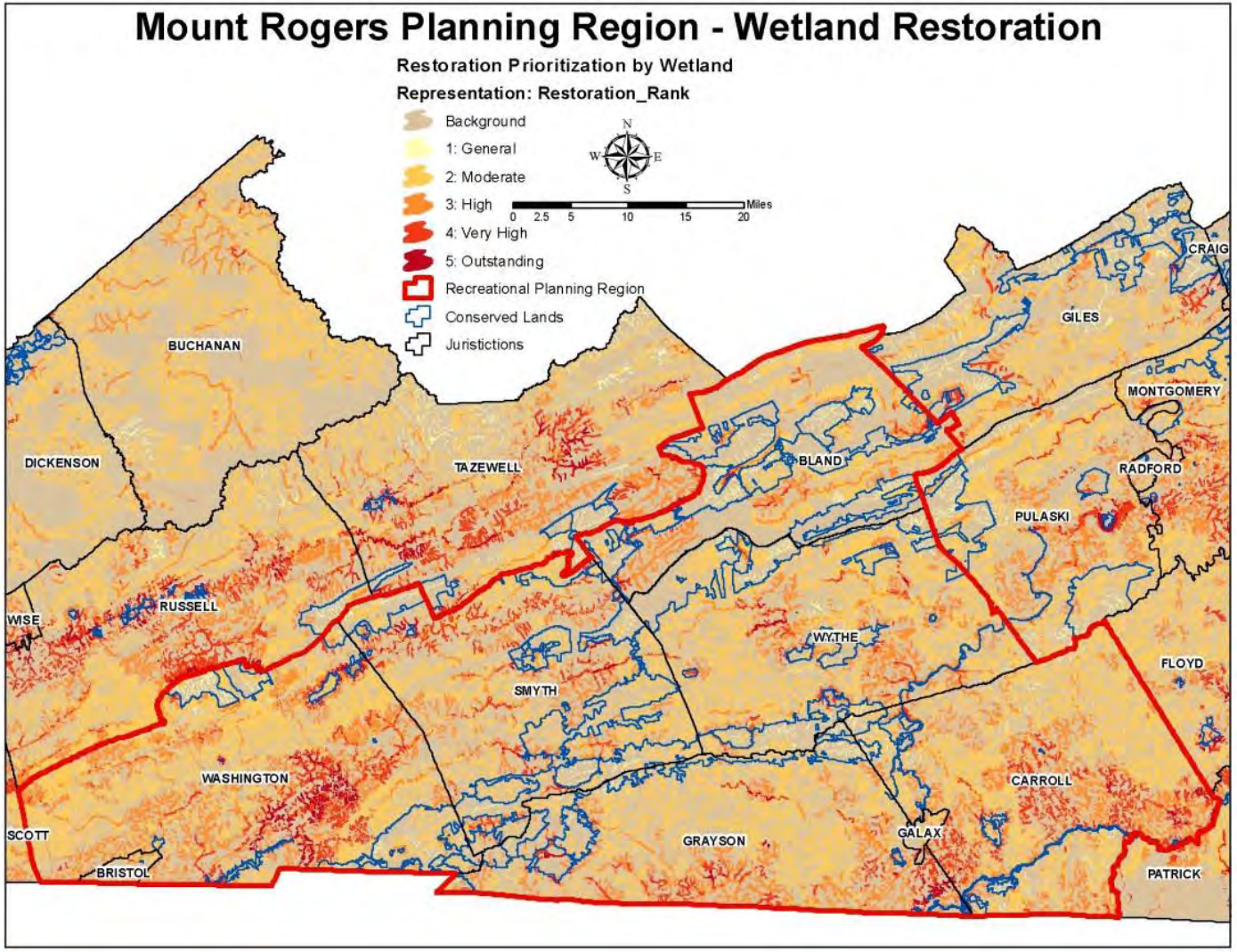

Figure 7. Wetland Restoration Priority Areas in Mount Rogers Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and enhancement of wetlands by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Mount Rogers Planning Region include cold and warm water rivers, streams, and creeks. Large watersheds include the Clinch, Holston, and Powell Rivers. Approximately 7,165 acres (0.4 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the brook trout, greenfin darter, sharphead darter, purple lilliput, fatlips minnow, Holston sculpin, Nelson's early black stonefly, Tennessee dace, and littlewing pearlymussel.

Threats

Aquatic and riparian habitats within the Mount Rogers Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Mount Rogers Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014a). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although Mount Rogers has some areas with a high percentage of impervious surface cover, the majority of the planning region has a low percentage of impervious surfaces (Figure 8).

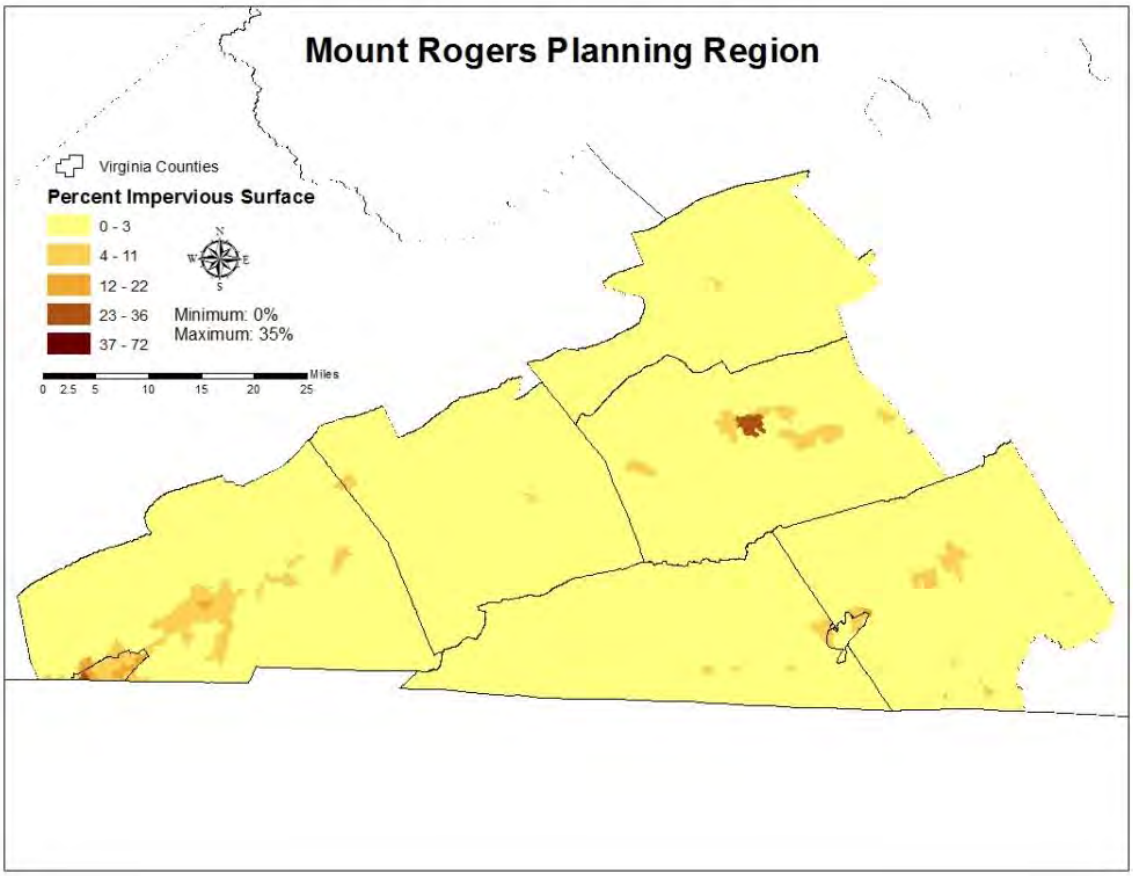

Figure 8. Impervious Surface Cover in Mount Rogers Planning Region (SARP 2014).

3. Catastrophic Spills: Catastrophic spills or other events can result in extensive loss of species and habitat in a short time period.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

6. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid

deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014). Streams may also become more alkaline due to mine runoff and underground mine pumping, which can also alter stream habitat.

7. Climate Change: Climate change will also affect both warm and coldwater streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Abrams Creek, Beaver Creek, Brumley Creek, Cove Creek, Laurel Creek, Lick Creek, Little Moccasin Creek, Locust Cove Creek, Logan Creek, Nordyke Creek, North Fork Holston River, Robertson Branch, Smith Creek, Toole Creek, Tumbling Creek, Turkey Run Creek, and Wolf Creek (MapTech 2013a); Beaver Creek and Little Creek (DCR 2007); Cedar Creek, Halls Creek, Hutton Creek, (MapTech 2001); Cripple Creek and Elk Creek (DEQ 2014b); Middle Fork Holston River and Wolf Creek (MapTech 2013b); and Reed Creek (Virginia Tech, DCR, and DEQ 2012) (Figure 9).

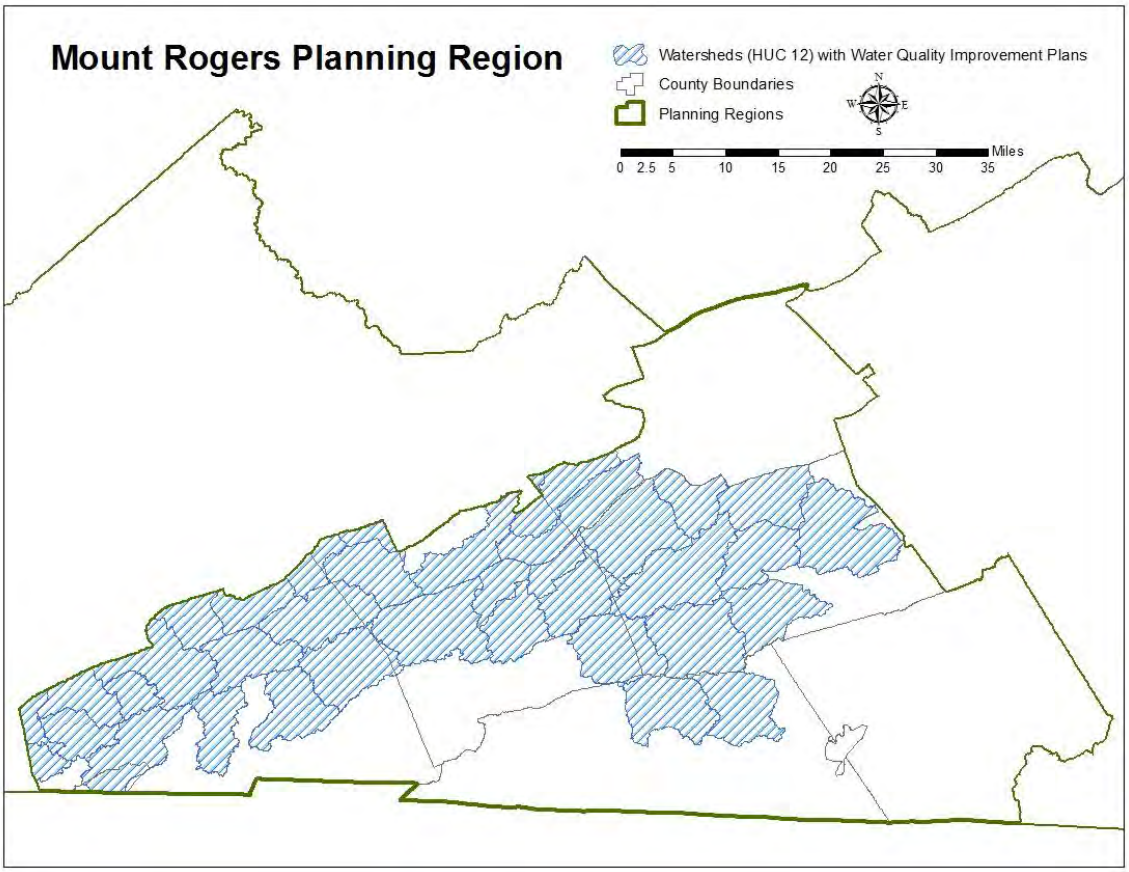

Figure 9. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Excluding livestock from streams;
- Establishing or enhancing vegetative and/ or forested buffers along streams and around sinkholes;
- Improving pasture, loafing lot, and barnyard management to prevent manure-tainted water from flowing into streams;
- Repairing or replacing failing septic systems and eliminating “straight pipes;”
- Restoring stream banks and establishing vegetative buffers along streams;
- Implementing conservation tillage practices;
- Establishing rain gardens, bioretention filters, and retention ponds;
- Establishing retention ponds to treat tainted runoff; and
- Reforesting highly erodible pasture lands.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 10).

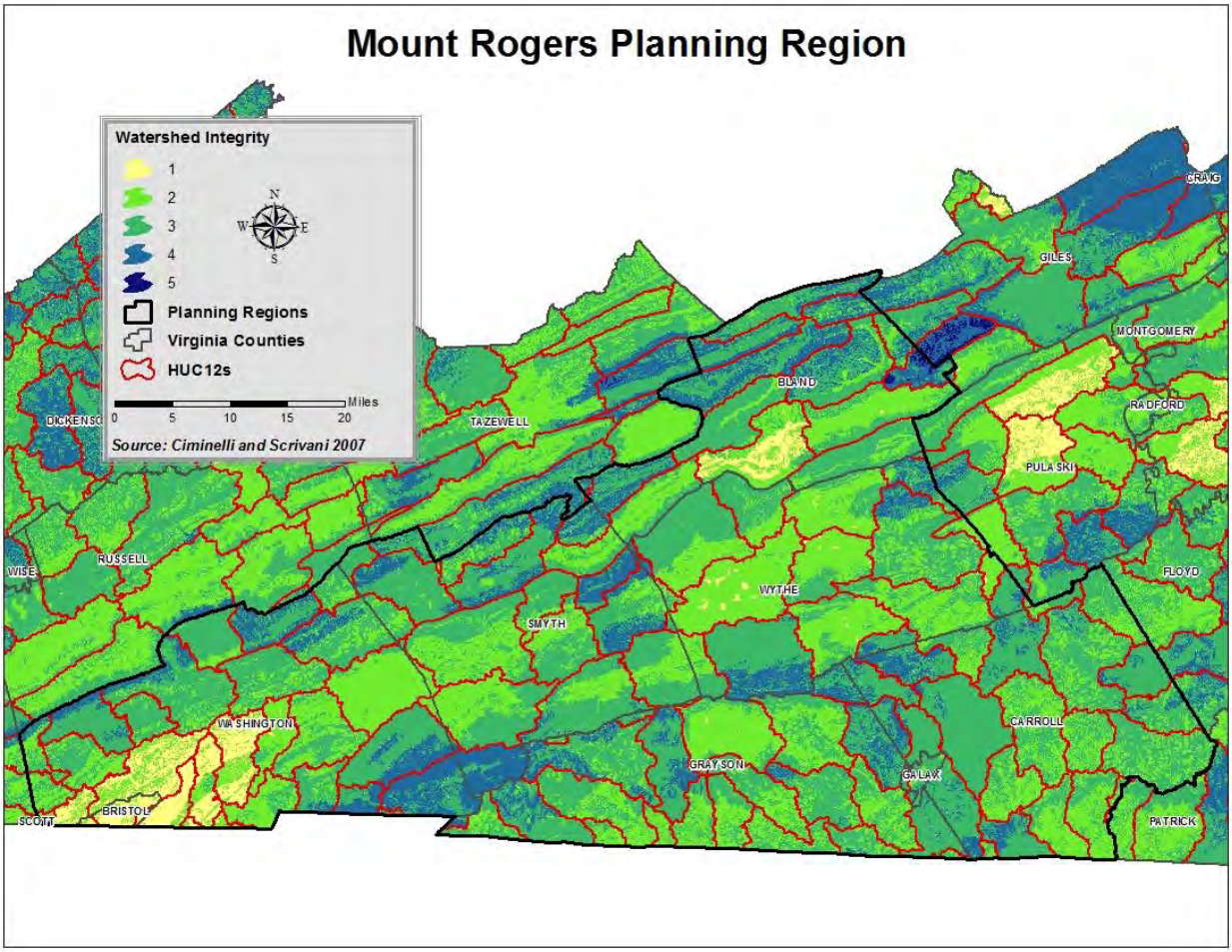

Figure 10. Watershed Integrity Model for Mount Rogers Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Mount Rogers Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Mount Rogers Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed and hardwood forests make up over half of the Mount Rogers Planning Region and are important for a broad range of species (Table 4). Within this forest type, young forests make up a specific age class of forest, loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods and conifers. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods and conifers. These forests help protect water resources within the region and provide habitat for species such as the including the red crossbill, Northern saw-whet owl, cerulean warbler, ruffed grouse, Northern pygmy salamander, and Carolina Northern flying squirrel, among other species.

Table 4. Forest Acreage Totals in Mount Rogers Planning Region (Anderson et al. 2013).

Forest Type	Acres	Percent of Planning Region
Spruce Fir	1,159.59	0.07%
Mixed Hardwood and Conifer	1,101,400.13	61.81%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Mount Rogers Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Mining and other extractive uses could also degrade habitat and affect species composition and water quality.

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note are the hemlock wooly adelgid and the gypsy moth, which has a significant effect on the ecology of oak-hickory forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

4. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the Mount Rogers Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot

buffer with no harvest (DOF 2014; A. Ewing, Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Reed Creek Watershed TMDL Implementation Plan Technical Report* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Reed Creek watershed to help decrease sediment run off as well as provide wildlife habitat (DEQ 2012). Similar actions are recommended for the Middle Fork Holston River and Wolf Creek watersheds (DCR 2013).

Several agencies, including DGIF, NRCS, DOF, and the U.S. Forest Service (USFS) advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Mount Rogers Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens and make up approximately 14,278 acres (0.8 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These areas provide habitat for the golden-winged warbler, grasshopper sparrow, loggerhead shrike, and Northern bobwhite quail, among other species.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF long recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. NRCS provides landowners with other opportunities including the Conservation Reserve Program and the Environmental Quality Incentives Program. Both the NBCI and the QRI have determined Bland County and Wythe County offer some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research is showing that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse composition of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-native species and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of open habitats will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Mount Rogers Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN MOUNT ROGERS PLANNING REGION

Complete SGCN list for the Mount Rogers Planning Region (SGCN=167). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibian		III	a	Blue Ridge two-lined salamander	*Eurycea wilderae*
Amphibian		III	a	Common mudpuppy	*Necturus maculosus maculosus*
Amphibian		IV	c	Cumberland Plateau salamander	*Plethodon kentucki*
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		II	b	Green salamander	*Aneides aeneus*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		II	a	Mountain chorus frog	*Pseudacris brachyphona*
Amphibian		III	c	Northern Pygmy salamander	*Desmognathus organi*
Amphibian		III	a	Shovel-nosed salamander	*Desmognathus marmoratus*
Amphibian		II	c	Southern zigzag salamander	*Plethodon ventralis*
Amphibian		I	b	Weller's salamander	*Plethodon welleri*
Amphibian		IV	c	Yonahlossee salamander	*Plethodon yonahlossee*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	c	Common ribbonsnake	*Thamnophis sauritus sauritus*

Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird		III	c	Red crossbill	*Loxia curvirostra*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	II	c	Incurved Cave isopod	*Caecidotea incurva*
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*
Crustacean		III	c	Reticulate crayfish	*ORCONECTES ERICHSONIANUS*
Crustacean		IV	c	Surgeon crayfish	*Orconectes forceps*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		IV	c	Appalachia darter	*Percina gymnocephala*
Fish		IV	c	Black sculpin	*Cottus baileyi*
Fish		IV	c	Blackside darter	*Percina maculata*
Fish		IV	c	Blotched chub	*Erimystax insignis*
Fish	**FS**	II	a	Blotchside logperch	*Percina burtoni*
Fish		IV	c	Bluebreast darter	*Etheostoma camurum*
Fish	**FS**	III	c	Bluestone sculpin	*Cottus sp. 1*
Fish		IV	c	Brook silverside	*Labidesthes sicculus*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*

Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*
Fish		II	c	Fatlips minnow	*Phenacobius crassilabrum*
Fish	**ST**	I	b	Greenfin darter	*Etheostoma chlorobranchium*
Fish		IV	c	Highback chub	*Hybopsis hypsinotus*
Fish	**FS**	III	c	Holston sculpin	*Cottus sp. 5*
Fish		III	c	Kanawha darter	*Etheostoma kanawhae*
Fish		III	c	Kanawha minnow	*Phenacobius teretulus*
Fish		IV	c	Logperch	*Percina caprodes*
Fish		III	c	Mirror shiner	*Notropis spectrunculus*
Fish		III	c	Mountain brook lamprey	*Ichthyomyzon greeleyi*
Fish		IV	c	Mountain shiner	*Lythrurus lirus*
Fish		IV	c	New River shiner	*Notropis scabriceps*
Fish		IV	c	Northern studfish	*Fundulus catenatus*
Fish		IV	c	Ohio lamprey	*Ichthyomyzon bdellium*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		IV	c	Piedmont darter	*Percina crassa*
Fish		II	c	Popeye shiner	*Notropis ariommus*
Fish		IV	c	Redlip shiner	*Notropis chiliticus*
Fish		III	b	River redhorse	*Moxostoma carinatum*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish		III	c	Rustyside sucker	*Thoburnia hamiltoni*
Fish	**SE**	I	c	Sharphead darter	*Etheostoma acuticeps*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
Fish	**FTST**	I	b	Spotfin chub	*Erimonax monachus*
Fish		IV	c	Stonecat	*Noturus flavus*
Fish		IV	b	Swannanoa darter	*Etheostoma swannanoa*
Fish		IV	c	Tangerine darter	*Percina aurantiaca*
Fish	**SE**	I	b	Tennessee dace	*Chrosomus tennesseensis*
Fish		III	c	Wounded darter	*Etheostoma vulneratum*
FW Mollusk	**ST**	III	a	Black sandshell	*Ligumia recta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk		III	c	Brown walker	*Pomatiopsis cincinnatiensis*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	a	Cumberland moccasinshell	*Medionidus conradicus*
FW Mollusk		II	c	Elktoe	*Alasmidonta marginata*

FW Mollusk	**FESE**	I	a	Fine-rayed pigtoe	*Fusconaia cuneolus*
FW Mollusk	**FC**	II	a	Fluted kidneyshell	*Ptychobranchus subtentum*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	c	Little-winged pearlymussel	*Pegias fabula*
FW Mollusk		III	a	Longsolid	*Fusconaia subrotunda*
FW Mollusk		IV	a	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk	**ST**	III	b	Pistolgrip	*Tritogonia verrucosa*
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusk	**FSSE**	II	c	Purple liliput	*Toxolasma lividus*
FW Mollusk	**FESE**	I	a	Rough rabbitsfoot	*Quadrula cylindrica strigillata*
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*
FW Mollusk	**FESE**	I	a	Shiny pigtoe	*Fusconaia cor*
FW Mollusk	**FCST**	II	a	Slabside pearlymussel	*Lexingtonia dolabelloides*
FW Mollusk	**SE**	I	b	Slippershell mussel	*Alasmidonta viridis*
FW Mollusk	**FPSE**	I	a	Snuffbox	*Epioblasma triquetra*
FW Mollusk	**FSST**	III	a	Spiny riversnail	*Io fluvialis*
FW Mollusk	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*
FW Mollusk	**FS**	II	a	Tennessee pigtoe	*Fusconaia barnesiana*
Insect	**FS**	I	a	Big stripetail stonefly	*Isoperla major*
Insect	**FSSE**	I	c	Buffalo Mountain mealybug	*Puto kosztarabi*
Insect	**FS**	II	c	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*
Insect	**FS**	II	c	Cherokee clubtail	*Gomphus consanguis*
Insect	**FS**	I	c	Cryptic willowfly	*Taeniopteryx nelsoni*
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*
Insect	**FS**	II	c	Maiden Spring cave beetle	*Pseudanophthalmus virginicus*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect		II	c	Pygmy snaketail	*Ophiogomphus howei*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect	**FS**	II	c	Silken cave beetle	*Pseudanophthalmus sericus*
Insect		III	a	Tennessee clubshell	*Pleurobema oviforme*
Insect	**FS**	II	c	Vicariant cave beetle	*Pseudanophthalmus vicarius*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal	**FESE**	I	c	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*

Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Aquatic Invertebrate	**FS**	I	c	A cave lumbriculid worm	*Stylodrilus beattiei*
Other Aquatic Invertebrate	**FS**	II	c	A cave lumbriculid worm	*Spelaedrilus multiporus*
Other Aquatic Invertebrate	**FS**	I	c	Chandler's planarian	*Sphalloplana chandleri*
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius regulus*
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia momus*
Other Terrestrial Invertebrate		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia armesi*
Other Terrestrial Invertebrate	**FS**	II	c	Big Cedar Creek millipede	*Brachoria falcifera*
Other Terrestrial Invertebrate		III	c	Flat button	*Mesomphix subplanus*
Other Terrestrial Invertebrate	**FSST**	I	c	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*
Other Terrestrial Invertebrate	**FS**	II	c	Montane centipede	*Escaryus cryptorobius*

Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*
Other Terrestrial Invertebrate	**FS**	II	c	Turner's millipede	*Brachoria turneri*
Other Terrestrial Invertebrate	**FS**	II	c	Whitetop Mountain centipede	*Escaryus orestes*
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*
Reptile		III	c	Cumberland slider	*Trachemys scripta troostii*
Reptile		III	c	Eastern black kingsnake	*Lampropeltis getula nigra*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Northern map turtle	*Graptemys geographica*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	a	Spiny softshell	*Apalone spinifera spinifera*
Reptile		IV	a	Stripe-necked musk turtle	*Sternotherus minor peltifer*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

15. New River Valley Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They are also based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and are found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

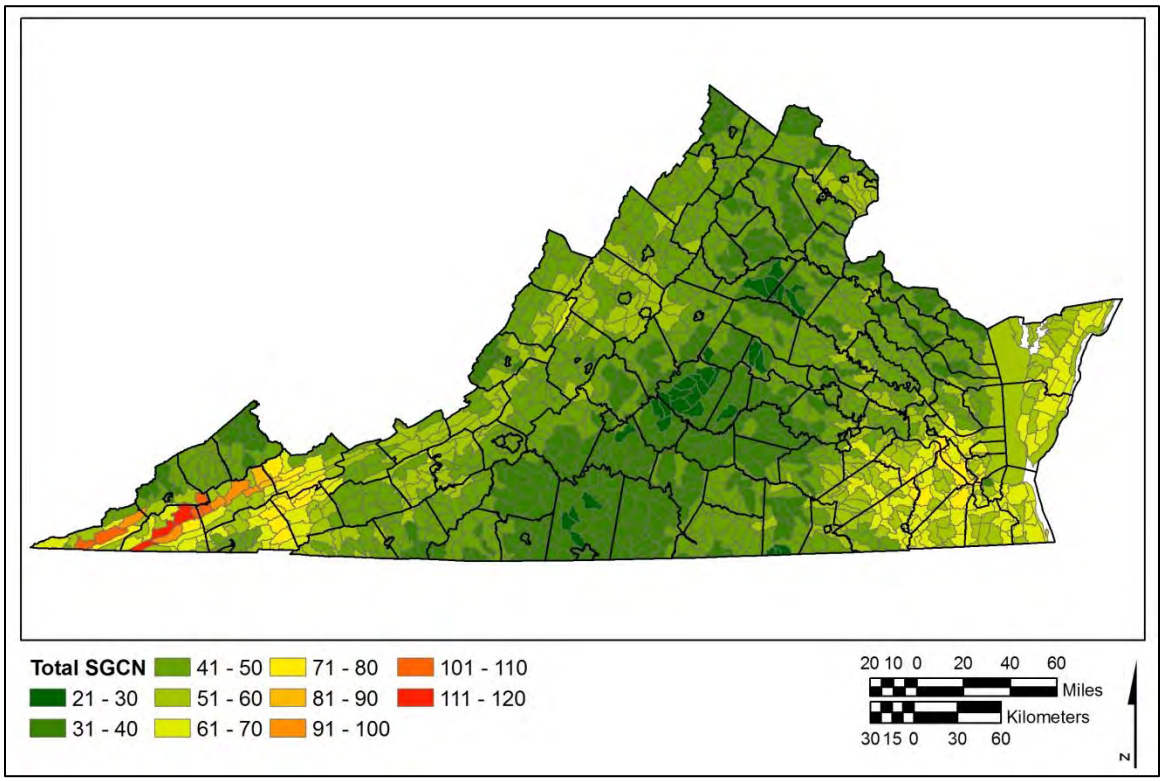

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

New River Valley Planning Region Summary Overview

The New River Valley Planning Region consists of 929,920 acres (1,453 square miles) and is predominantly rural with several larger cities. The region includes the counties of Floyd, Giles, Montgomery, and Pulaski; the towns of Blacksburg, Christiansburg, Floyd, Narrows, Pearisburg, Pulaski, and Rich Creek; and the city of Radford. The human population in this planning region is estimated to be almost 182,000 people (US Census Bureau 2015). Virginia Tech University and Radford University students make up approximately 20 percent of the human population in the region (DCR 2013). Populations are projected to increase if the average growth rate for the planning region is maintained or increase (DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including eight species that occur only within this region and nowhere else in the world. They include the New River Valley cave beetle, Straley's cave beetle, Mitchell's satyr butterfly, Virginia fringed mountain snail, Buffalo Mountain mealybug, Ellett Valley pseudotremia (cave obligate invertebrate), Pygmy snaketail (dragonfly), and Laurel Creek xystodesmid millipede. The planning region includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

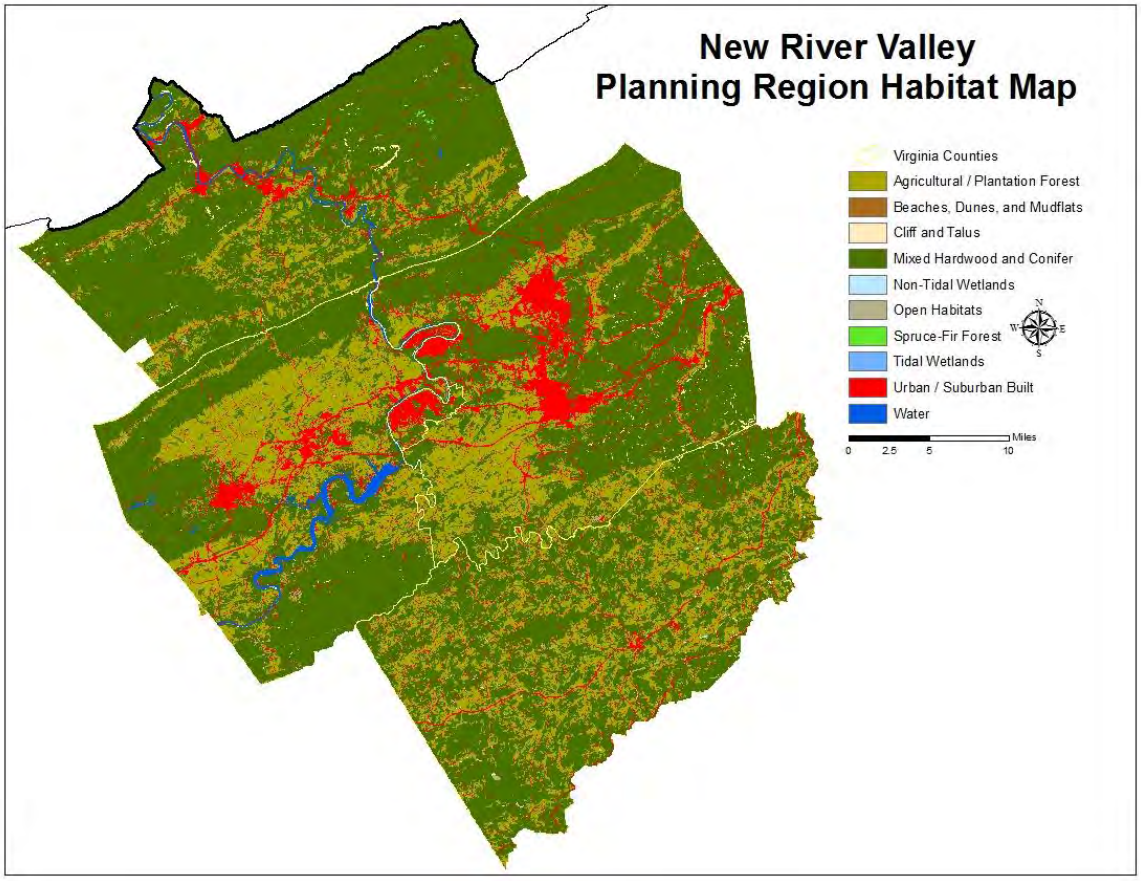

Figure 2. New River Valley Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 115 are believed to either occur, or have recently occurred, within the New River Valley Planning Region (Appendix A). Of these 116 species, ***78 SGCN are dependent upon habitats provided within the New River Valley Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 77 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species

that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	8
Ib	3
Ic	7
IIa	2
IIb	2
IIc	12
IIIa	6
IIIb	3
IIIc	6
IVa	13
IVb	6
IVc	10

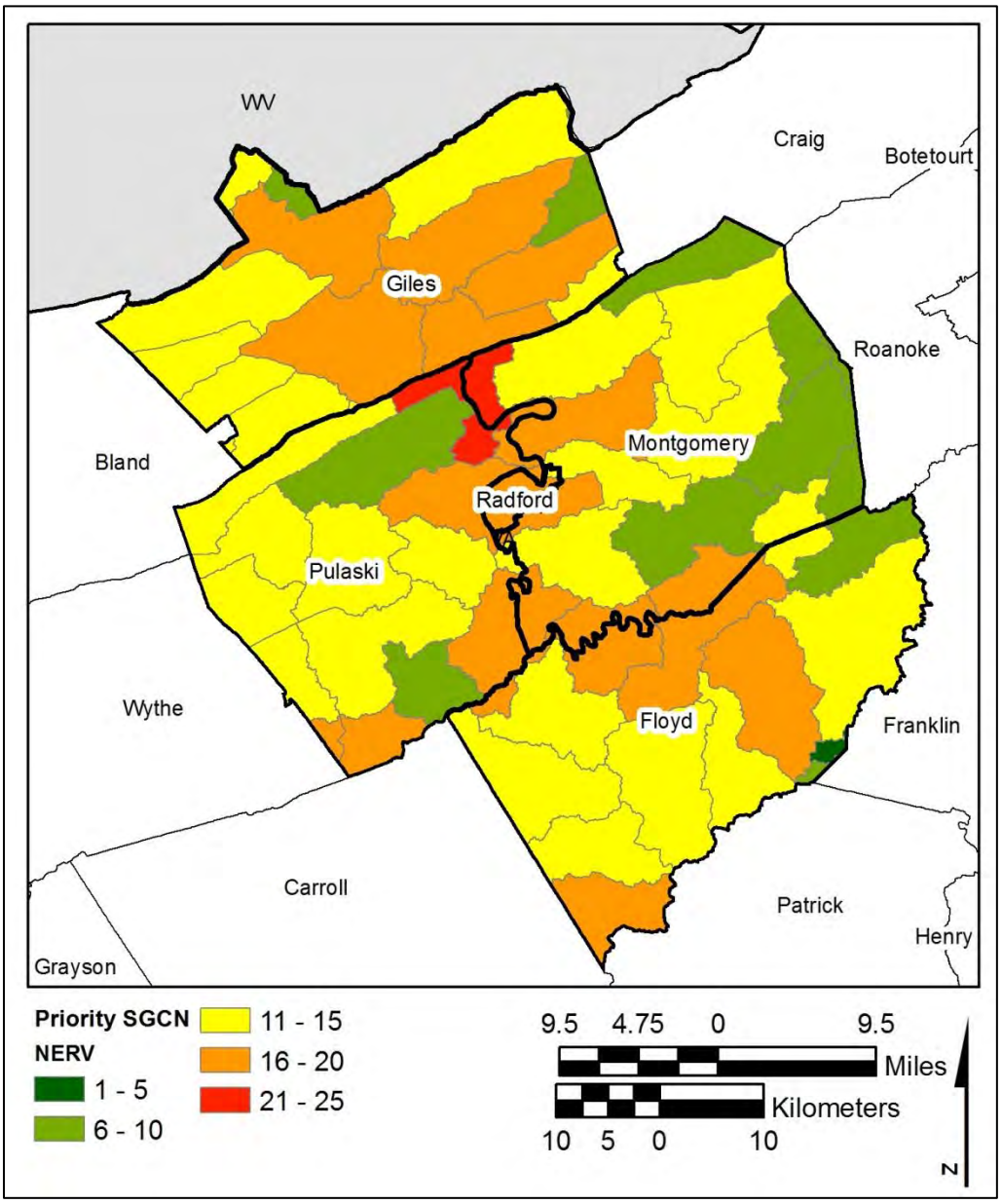

Figure 3. Priority SGCN Density in the New River Valley Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the New River Valley Planning District.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*	High elevation seeps, streams, wet rock faces, and riparian forests
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	Clean streams and rivers with rocky substrates
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*	West of Shenandoah River - high elevation hardwood forests
Amphibian		III	a	Shovel-nosed salamander	*Desmognathus marmoratus*	Cool highly oxygenated high elevation streams with moderate flow and gravel and rock substrates
Amphibian		IV	c	Yonahlossee salamander	*Plethodon yonahlossee*	Mature hardwood forests with deep leaf litter layer
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth.

Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*	Open shrubby habitat (ex. old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens (AOU 1983), dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.
Bird	**ST**	I	a	Henslow's sparrow	*Ammodramus henslowii*	Open fields and meadows with grass interspersed with weeds or shrubby vegetation, especially in damp or low-lying areas, adjacent to salt marsh in some areas.
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest dense second growth, swamps.
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks

Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah river
Bird		III	c	Red crossbill	*Loxia curvirostra*	Spruce-fir or hemlock forests above 4000 feet
Bird		III	a	Ruffed Grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	a	Whimbrel	*Numenius phaeopus*	Coastal migrant
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Crustacean	**FS**	I	a	Ephemeral cave amphipod	*Stygobromus ephemerus*	Cave/ Karst
Crustacean	**FS**	II	c	Henrot's Cave isopod	*Caecidotea henroti*	Cave/ Karst
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*	Clean creeks and streams with sand, gravel, clay, or silt substrates
Crustacean	**FS**	II	c	Montgomery County cave amphipod	*Stygobromus fergusoni*	Cave/ Karst
Fish		IV	c	Appalachia darter	*Percina gymnocephala*	Clear, cool and warm streams in the New River drainage with upland gradient and gravel substrates
Fish		IV	c	Blackside darter	*Percina maculata*	Clean streams and rivers with moderate gradient and various substrates
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*	Clear creeks and streams with rocky substrates
Fish		III	c	Kanawha darter	*Etheostoma kanawhae*	Clear creeks and streams with rocky substrates
Fish		III	c	Kanawha minnow	*Phenacobius teretulus*	Clear moderate gradient streams with clean gravel and rubble substrates

Fish		IV	c	Logperch	*Percina caprodes*	Warm, moderate gradient, streams and rivers with gravel and rubble substrates
Fish		IV	c	New River shiner	*Notropis scabriceps*	Small to large, cool water, tributaries of the New River with high to moderate gradient and unsilted substrates
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*	Moderate to strong flows with unsilted substrates
Fish		IV	c	Redlip shiner	*Notropis chiliticus*	Clear creeks and streams with moderate gradient, warm or cool water and various substrates
Fish		III	c	Rustyside sucker	*Thoburnia hamiltoni*	Clean clear streams with moderate to high gradient and unsilted substrates
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*	Moderate gradient streams and rivers with unsilted gravel, rubble, and boulder substrates
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*	Springs and cave streams in the Potomac basin and along the Blue Ridge
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*	Clean, calm water in streams and rivers of various sizes with sand and gravel substrates
FW Mollusk	**ST**	III	b	Pistolgrip	*Tritogonia verrucosa*	Large rivers with gravel, sand, or mud substrates
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*	If this species is consistent with other species in this genus, clean mid-sized rivers with fast flows and rocky substrates
FW Mollusk	**FESE**	I	a	Virginia fringed mountain snail	*Polygyriscus virginianus*	Forest
Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus gracilis*	Caves with clean abundant water flowing through the system.
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil
Insect	**FSSE**	I	c	Buffalo Mountain mealybug	*Puto kosztarabi*	South slope of Buffalo Mountain in Floyd county on poverty oatgrass in open glades
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*	Large rivers with rocks and moderate current
Insect	**FESE**	I	c	Mitchell's satyr	*Neonympha mitchellii*	Wetland
Insect	**FS**	II	c	New River Valley cave beetle	*Pseudanophthalmus egberti*	Cave/ Karst
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens/ oak savanna and other open sunny habitats

Insect		II	c	Pygmy snaketail	*Ophiogomphus howei*	Large fast flowing rivers
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*	Glades and prairie remnants
Insect	**FS**	II	c	Spotted cave beetle	*Pseudanophthalmus punctatus*	Cave/ Karst
Insect	**FS**	II	c	Straley's Cave beetle	*Pseudanophthalmus quadratus*	Cave/ Karst
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*	Dry habitats including clearings, open woods, and roadsides containing wavy-leaved asters
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia sublevis*	Cave/ Karst
Other Terrestrial Invertebrate		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FSST**	I	c	Ellett Valley Pseudotremia millipede	*Pseudotremia cavernarum*	Cave/ Karst
Other Terrestrial Invertebrate	**FSST**	I	c	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*	Known from one location where it occurs under leaf litter of rhododendrons and hardwoods within 5 meters of stream
Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*	Known from four locations and occupies leaf litter at the base of limestone/ shale outcropings
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*	Emergent wetlands with dense vegetation

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the New River Valley Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national forests to state parks and wildlife management areas to conservation easements. Significant conservation assets, in terms of size, include:

- Jefferson National Forest,
- Blue Ridge Parkway,
- Claytor Lake State Park,
- New River Trail State Park,
- Selu Conservancy (Radford University), and
- Mountain Lake Biological Station (UVA).

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities. Additionally, military lands that contain habitats and fish and wildlife species can also be valuable to conservation, such as Radford Army Ammunition Plant.

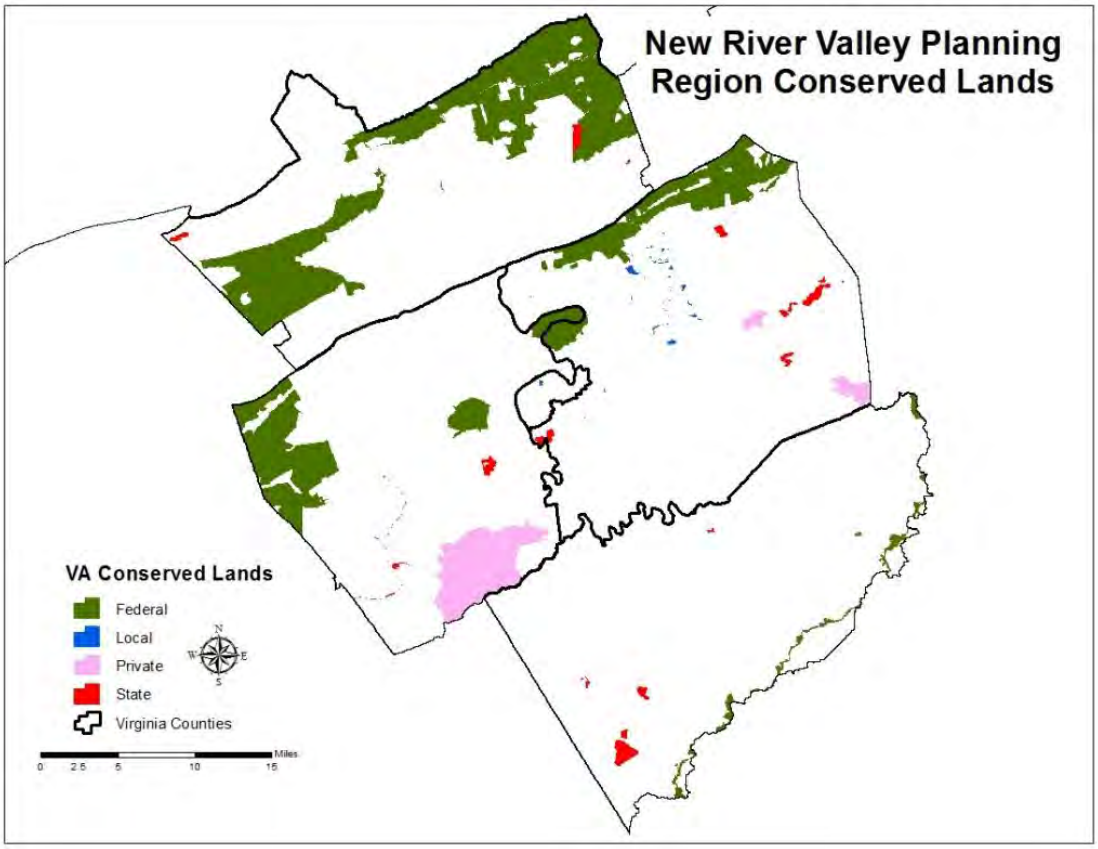

Figure 2. Conservation Lands in the New River Valley Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within the New River Valley Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the New River Valley Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the New River Valley Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the Appalachians than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the New River Valley Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many of the New River Valley Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the New River Valley Planning Region.

Conservation Strategy	Conservation Action	Threats addressed	Economic/ Human benefits	Priority areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Increasing industrial/residential water consumption, sedimentation and pollutants, protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands identified by DCR
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated and/ or forested riparian buffers; 2) Work to restore or create wetlands; 3) Restore and revegetate stream banks and channels; 4) Reforest erodible upland areas and disturbed areas; 5) Establish riparian forests, wetlands, infiltration trenches, and other areas to slow runoff and encourage infiltration; 6) Improve pasture management to prevent manure and tainted sediment from flowing into streams; 7) Exclude livestock from streams; 8) Harvest forest products utilizing available BMPs; 8) Repair or replace failing septic systems and eliminating "straight pipes;" 9) Implement a program to encourage urban storm water infiltration; 10) Implement a pet waste disposal program; 11) Implement erosion and sediment control efforts in residential areas; 12)	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to water supply	Back Creek, Crab Creek, Dodd Creek, Mill Creek, Little River, Upper Stroubles Creek

	Improve wastewater disposal for downtown businesses; 13) Enhance street sweeping;14) Reduce the improper disposal of grass clippings and trash; 15) Continue to identify impaired waters within the planning region; 16) Restore aquatic connections; 17) Monitor and address invasive species impacts; and 18) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.			
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The New River Valley Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for many SGCN, including the New River and Straley's cave beetles, Montgomery County cave amphipod, and a wide variety other important species. Others species such as the Indiana bat and Virginia big-eared bat depend on karst habitat and are endangered throughout their range. Caves in this planning region provide crucial winter habitat for some bat species.

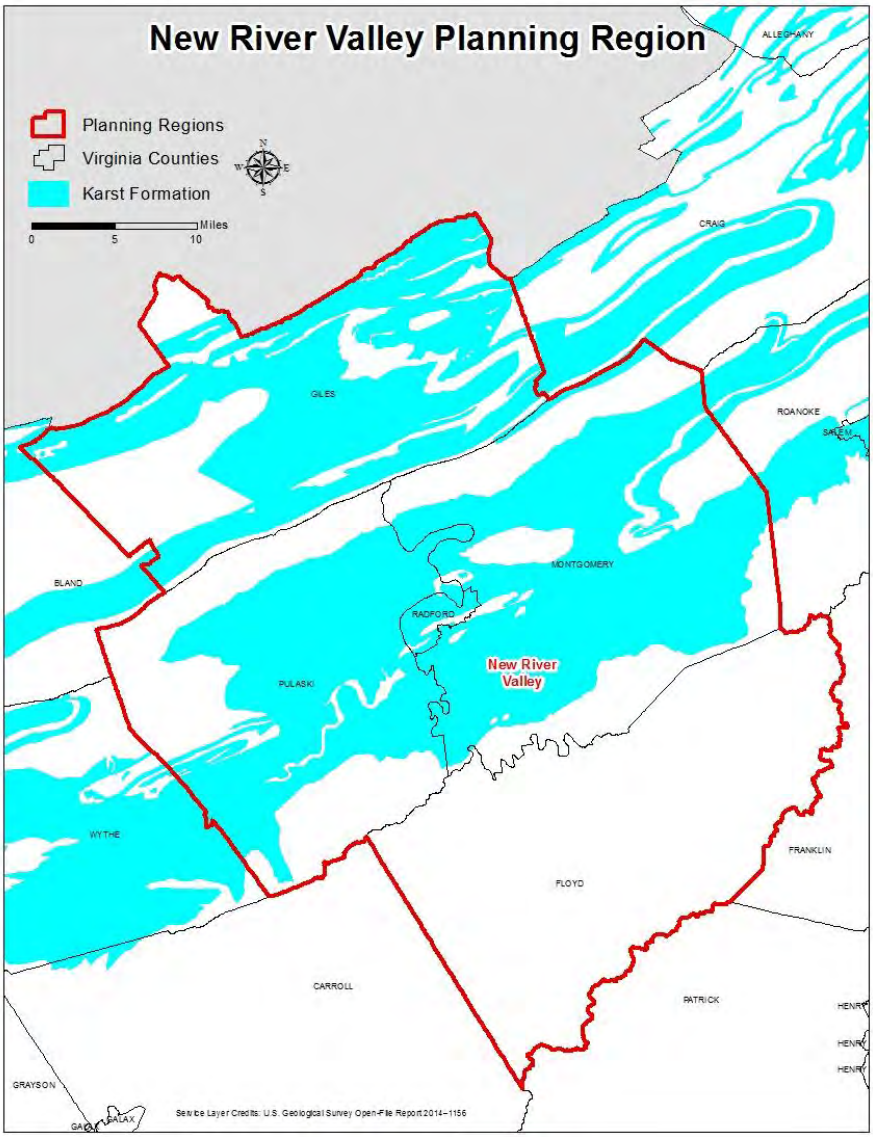

Figure 5. Karst Areas in the New River Valley Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems is affected by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites as well as through development and resulting pollutant-laden runoff (DCR 2008).

2. Altered Hydrology: The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography. Development and other activities which increase the amount of impervious surface can also play a role in changing water flow patterns and altering how much water flows into a karst system.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Plant species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change as with increased storm intensity will result in more stormwater runoff.

Maintain and Restore Wetland Habitats

An extremely small percentage of the New River Valley Planning Region is non-tidal wetland habitat (approximately 1,153 acres or 0.12 percent of the planning region) (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for the bog turtle and whimbrel. Additionally, the Mitchell's satyr butterfly is found only within wetland habitats in this planning region.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When BMP are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that result in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation. Examples of invasive species affecting these non-tidal wetlands include Japanese stilt grass and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the New River Valley Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the New River Valley Planning Region include those wetlands that would allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 6) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). Highest priority areas for conservation are adjacent to already protected lands in many parts of the planning region, providing a good opportunity for potential expansion. The highest restoration priority areas are adjacent to already conserved lands in some counties but other priority areas are not, such as is Floyd and Montgomery counties.

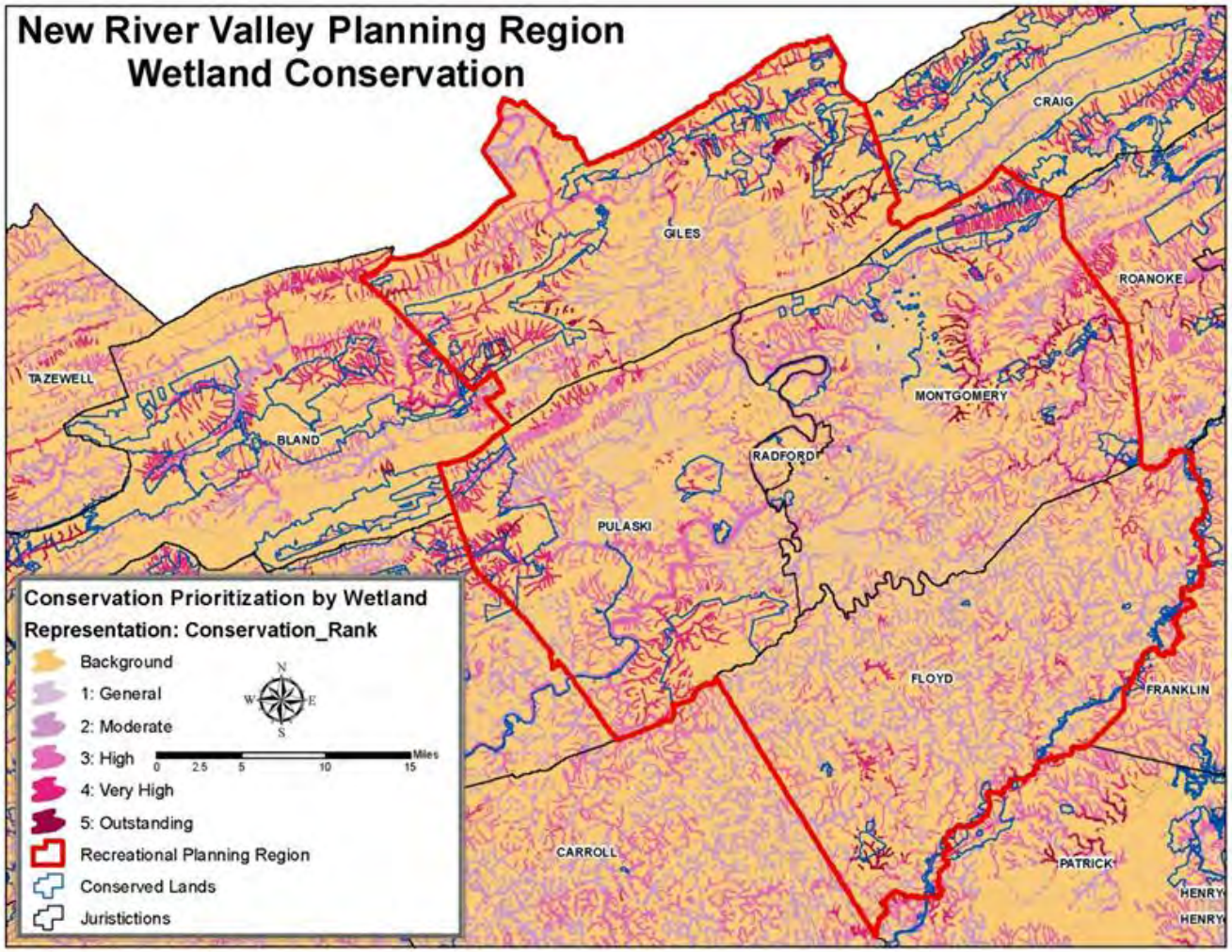

Figure 6. Wetlands Conservation Priority Areas in the New River Valley Planning Region (Weber and Bulluck 2014).

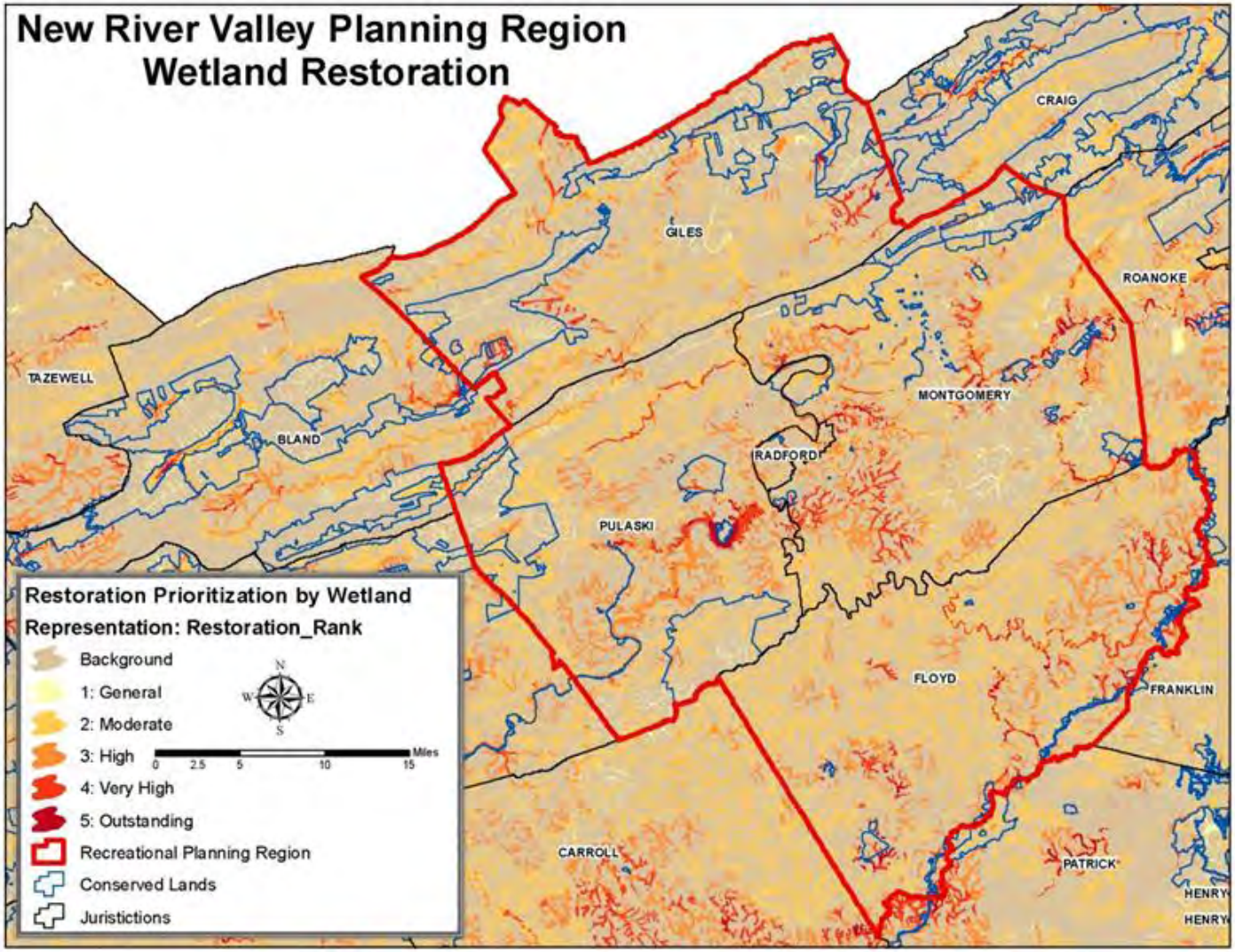

Figure 7. Wetlands Restoration Priority Areas in the New River Valley Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and enhancement of wetlands by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the New River Valley Planning Region include cold and warm water rivers, streams, and creeks. The majority of this planning region is in the New River watershed, but it also includes headwaters for the James and the Roanoke Rivers. Approximately, 10,200 acres (1.1 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the candy darter, New River crayfish, eastern hellbender, pistolgrip, brook trout, and New River shiner.

Threats

Aquatic and riparian habitats within the New River Valley Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the New River Valley Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although the New River Valley Planning Region has some areas with a high percentage of impervious surface cover, overall the planning region has a low percentage of impervious surface cover (Figure 8).

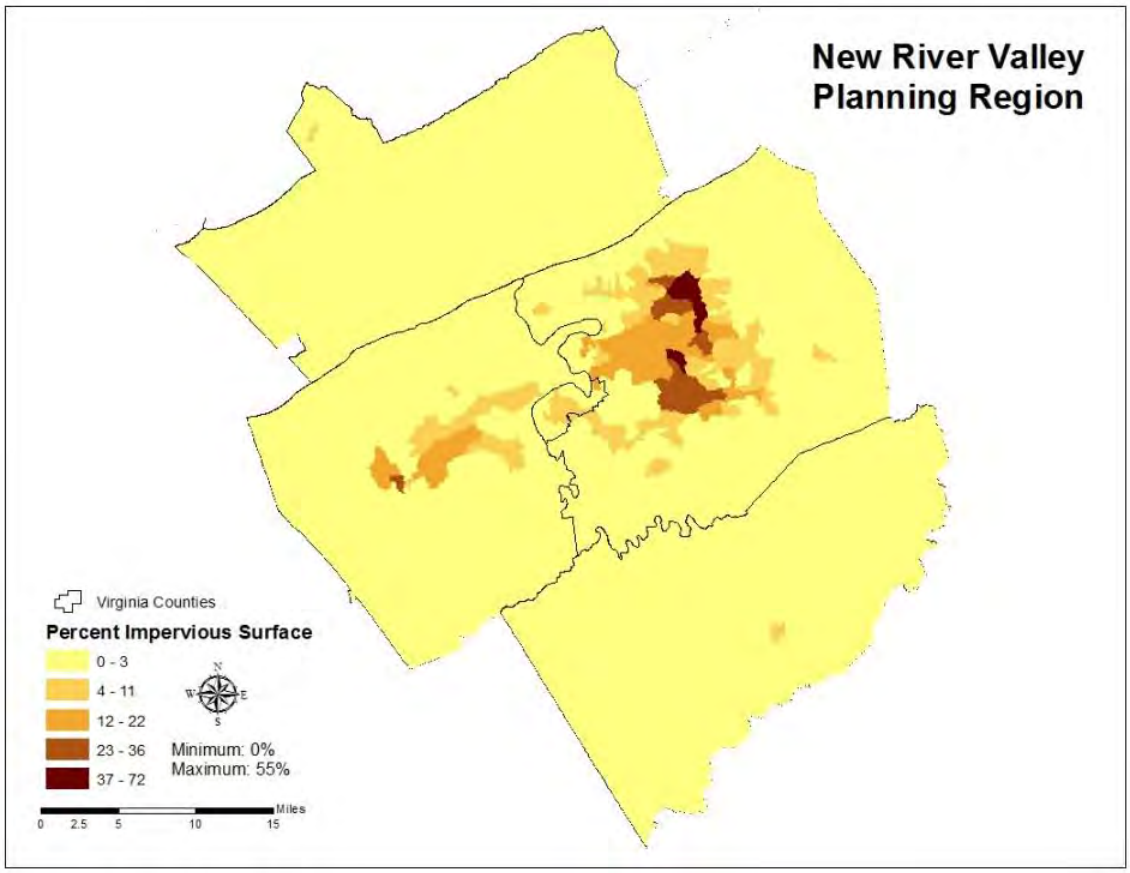

Figure 8. Impervious Surface Cover in New River Valley Planning Region (SARP 2014).

3. Catastrophic Spills: Catastrophic spills from industrial sites or road crossings can result in extensive loss of species and habitat in a short time period.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

6. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid

deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014). Streams may also become more alkaline due to mine runoff and underground mine pumping, which can also alter stream habitat.

7. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Back Creek (New River – Highlands RC&D 2006), Crab Creek (Crab Creek IP Steering Committee 2014), Dodd Creek (DCR and MapTech 2006b), Mill Creek (DCR and MapTech 2006b), Little River (MapTech and New River-Highlands 2011), and Upper Stroubles Creek (Stroubles Creek Steering Committee 2006) (Figure 9).

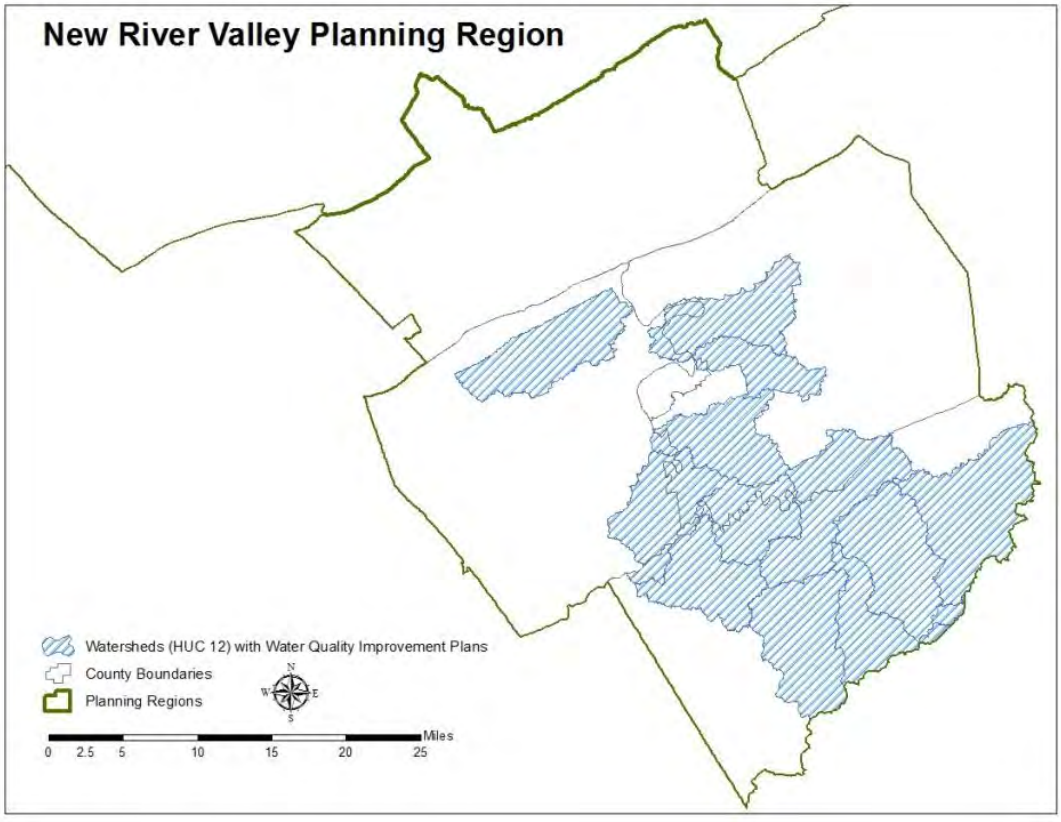

Figure 9. Watersheds with Water Quality Improvement Plan.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated and/ or forested riparian buffers;
- Working to restore or create wetlands;
- Restoring and revegetating stream banks and channels;
- Reforesting erodible upland areas and disturbed areas;
- Improving pasture management to prevent manure and tainted sediment from flowing into streams;
- Excluding livestock from streams;
- Harvesting forest products utilizing available BMPs;
- Repairing or replacing failing septic systems and eliminating “straight pipes” that deposit human waste into the stream;
- Implementing a program to encourage storm water infiltration including rain gardens, bioretention ponds, and other techniques;
- Implementing a pet waste disposal program including waste stations and digesters;
- Implementing erosion and sediment control efforts in residential areas;
- Relocating a gravel road in a riparian area between Horse Farm and Rt. 460);
- Restoring culvert capacity along Kabrich Street;
- Upgrading culverts along Rt. 460;
- Improving wastewater disposal for downtown businesses;
- Enhancing street sweeping;
- Reducing the improper disposal of grass clippings and trash;
- Detecting and eliminate illicit storm water discharges to the sanitary sewer system;
- Establishing an ordinance prohibiting illegal dumping and non-storm water discharges to streams; and
- Establishing an education and outreach campaign to promote efforts to improve water quality within this watershed.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 10).

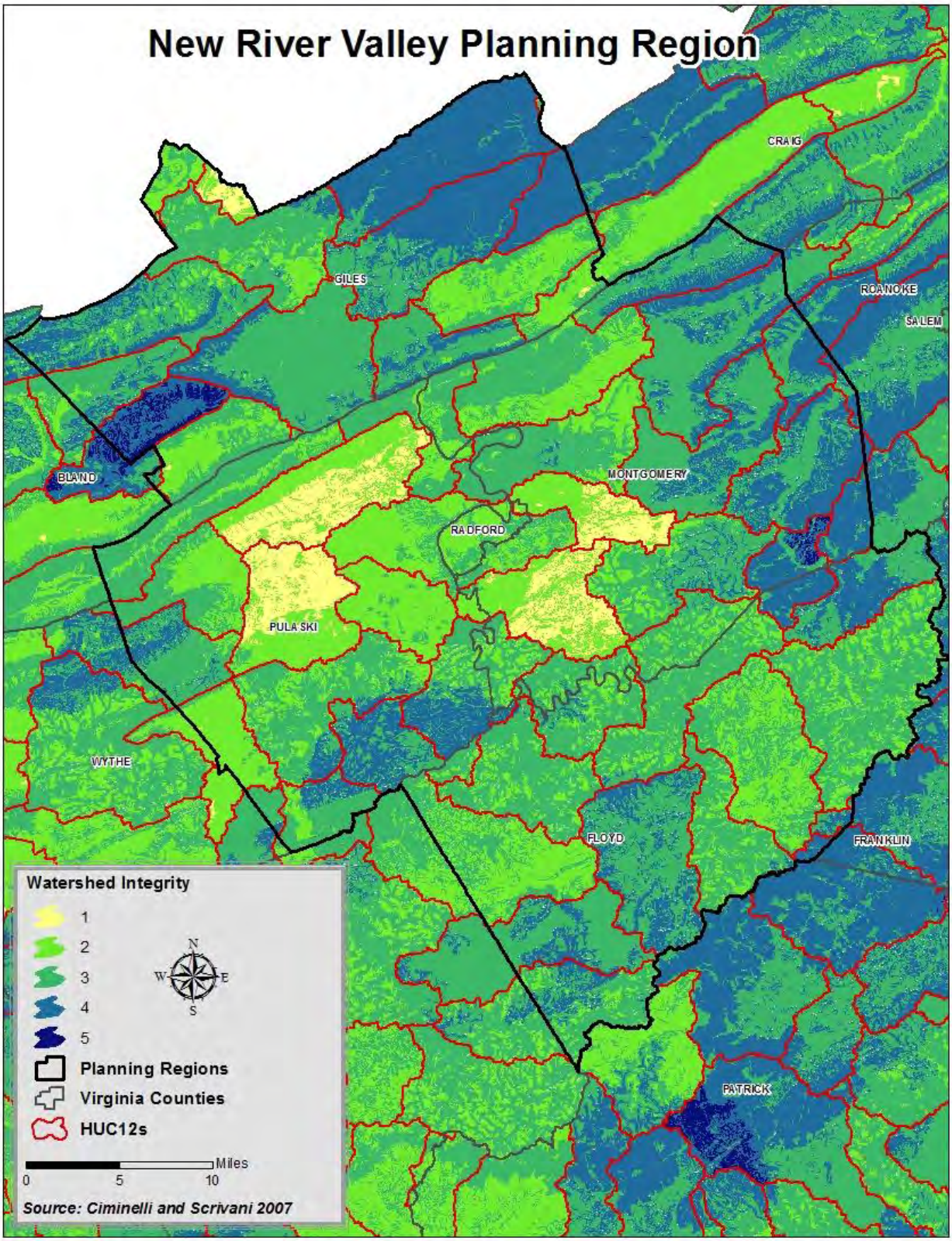

Figure 10. Watershed Integrity Model for New River Valley Planning Region (Criminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the New River Valley Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the New River Valley Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost two thirds of the New River Valley Planning Region and are important for a broad range of species (Table 4). Within this forest type, young forests make up a specific age class of forest, loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Spruce-fir forests make up a very small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods and conifers. These forests help protect water resources within the region and provide habitat for species such as the Yonahlossee salamander, Jefferson salamander, and Northern saw-whet owl, among others.

Table 4. Forest Acreage Totals in the New River Valley Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Spruce Fir	131.22	0.01%
Mixed Hardwood and Conifer	613,009.04	65.11%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the New River Valley Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, then impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Mining and other extractive uses could also degrade habitat and affect species composition and water quality.

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the hemlock wooly adelgid. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

4. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the New River Valley Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Draft Crab Creek Bacteria and Sediment TMDL Implementation Plan* developed by stakeholders and DEQ specifically highlights reforesting areas around eroding crop lands and pastures within the Crab Creek watershed to help decrease sediment run off as well as provide wildlife habitat (Crab Creek IP Steering Committee 2014). Similar actions are recommended for the Little River watersheds (MapTech and New River-Highlands 2011)

Several agencies, including DGIF, NRCS, DOF, and the USFS advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the New River Valley Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised,

depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for action plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens and make up approximately 3,240 acres (0.34 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These areas provide habitat for the golden-winged warbler, Henslow's sparrow, loggerhead shrike, Persius duskywing butterfly, Buffalo Mountain mealybug, and Appalachian grizzled skipper, among others.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Many glade habitats occur within this planning region. The majority occur on conserved lands. Conserving these habitats will require managing invasive species, maintain the vegetative communities with fire, and managing the recreations uses of these areas to prevent the unique plant communities from being trampled.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our

problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the New River Valley Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN NEW RIVER VALLEY PLANNING REGION

Complete SGCN list for the New River Valley Planning Region (SGCN=115). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		II	a	Mountain chorus frog	*Pseudacris brachyphona*
Amphibian		III	a	Shovel-nosed salamander	*Desmognathus marmoratus*
Amphibian		IV	c	Yonahlossee salamander	*Plethodon yonahlossee*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*

Bird		IV	b	Green heron	*Butorides virescens*
Bird	**ST**	I	a	Henslow's sparrow	*Ammodramus henslowii*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	c	Red crossbill	*Loxia curvirostra*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		II	b	Swainson's warbler	*Limnothlypis swainsonii*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	I	a	Ephemeral cave amphipod	*Stygobromus ephemerus*
Crustacean	**FS**	II	c	Henrot's Cave isopod	*Caecidotea henroti*
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*
Crustacean	**FS**	II	c	Montgomery County cave amphipod	*Stygobromus fergusoni*
Fish		IV	c	Appalachia darter	*Percina gymnocephala*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish		IV	c	Blackside darter	*Percina maculata*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*
Fish		III	c	Kanawha darter	*Etheostoma kanawhae*
Fish		III	c	Kanawha minnow	*Phenacobius teretulus*
Fish		IV	c	Logperch	*Percina caprodes*
Fish		IV	c	New River shiner	*Notropis scabriceps*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		IV	c	Redlip shiner	*Notropis chiliticus*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*

Fish		III	c	Rustyside sucker	*Thoburnia hamiltoni*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk	**ST**	III	b	Pistolgrip	*Tritogonia verrucosa*
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*
FW Mollusk	**SE**	II	a	Tennessee heelsplitter	*Lasmigona holstonia*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus gracilis*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FSSE**	I	c	Buffalo Mountain mealybug	*Puto kosztarabi*
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*
Insect	**FESE**	I	c	Mitchell's satyr	*Neonympha mitchellii*
Insect	**FS**	II	c	New River Valley cave beetle	*Pseudanophthalmus egberti*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect		II	c	Pygmy snaketail	*Ophiogomphus howei*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect	**FS**	II	c	Spotted cave beetle	*Pseudanophthalmus punctatus*
Insect	**FS**	II	c	Straley's Cave beetle	*Pseudanophthalmus quadratus*
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*

Other Terrestrial Invertebrates	**FS**	II	c	A millipede	*Pseudotremia sublevis*
Other Terrestrial Invertebrates		II	c	A millipede	*PSEUDOTREMIA TUBERCULATA*
Other Terrestrial Invertebrates	**FSST**	I	c	Ellett Valley Pseudotremia millipede	*Pseudotremia cavernarum*
Other Terrestrial Invertebrates	**FSST**	I	c	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*
Other Terrestrial Invertebrates	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*
Other Terrestrial Invertebrates	**FESE**	I	a	Virginia fringed mountain snail	*Polygyriscus virginianus*
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

16. Northern Neck Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and*

Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

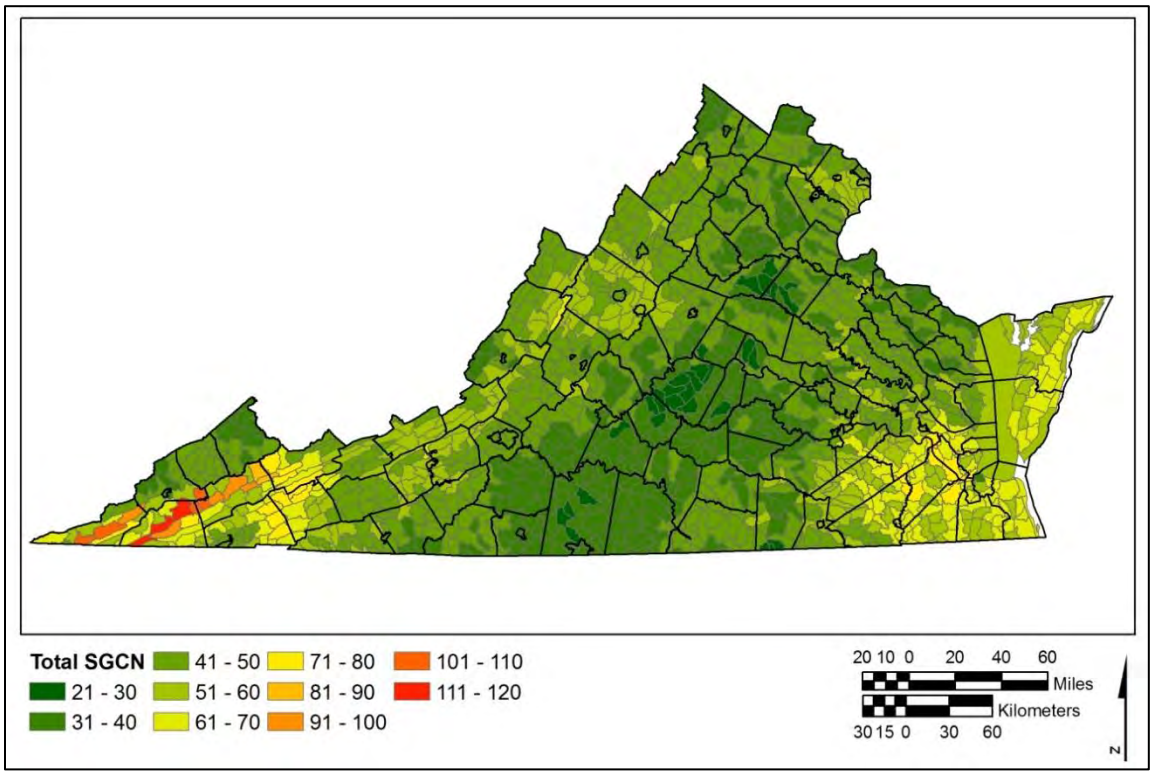

Figure 1. State distribution of Species of Greatest Conservation Need (HUC12 Watersheds).

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, local threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions (DCR 2013a). Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

NORTHERN NECK PLANNING REGION SUMMARY OVERVIEW

The Northern Neck Planning Region is largely rural and consists of 633,142 acres (989 square miles) and includes Lancaster, Northumberland, Richmond, and Westmoreland counties. The human population in this planning region is estimated to be almost 50,000 people. All counties are projected to experience human population growth by 2030 (VIMS 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. The aquatic habitats of this planning region are especially important for the migratory Atlantic sturgeon and Lancaster County Amphipod. Its wetlands provide habitats for migratory brants, black-crowned night-heron, tri-color heron, and the seaside sparrow. The Northeastern beach tiger beetle uses its beaches as nesting habitat. The planning region includes a variety of other habitats such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, tidally influenced streams and riparian habitats, beaches and dunes and mudflats, and estuarine habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

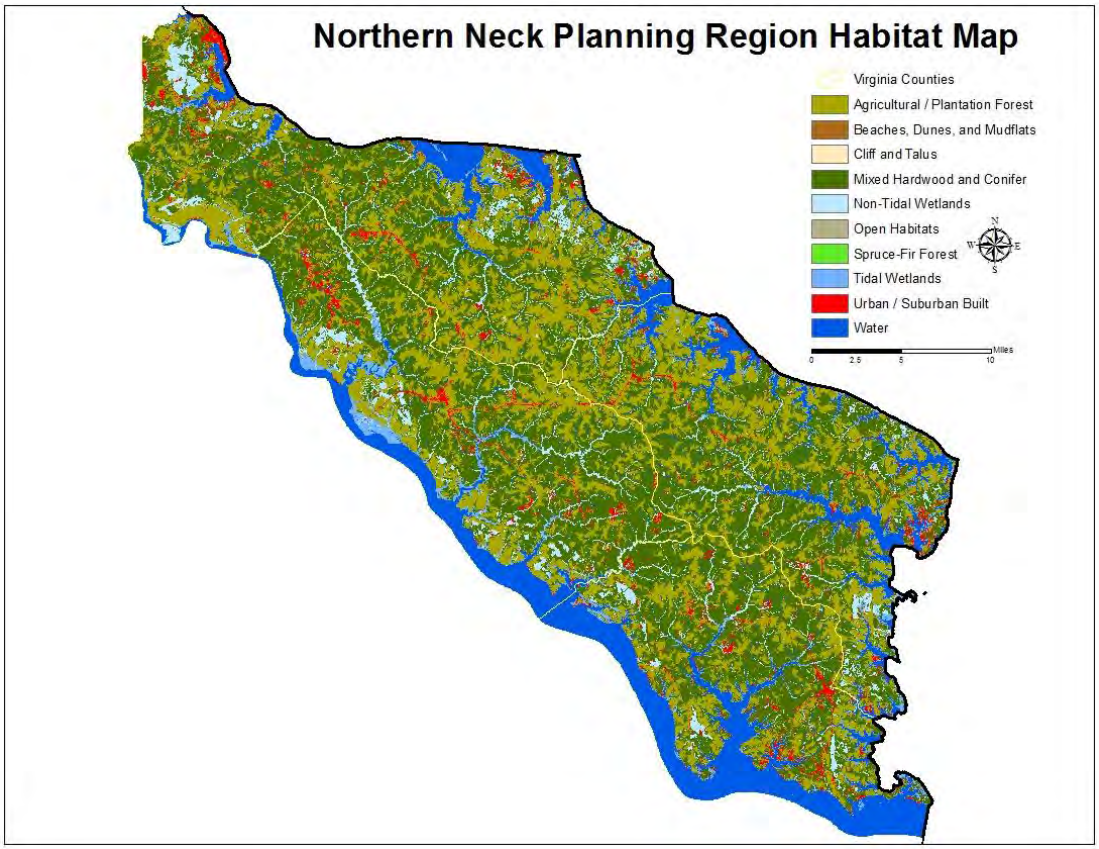

Figure 2. Northern Neck Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 65 are believed to either occur, or have recently occurred, within the Northern Neck Planning Region (Appendix A). Of these 65 species, ***31 SGCN are dependent upon habitats provided within the Northern Neck Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 31 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species

that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	2
Ib	1
Ic	1
IIa	1
IIb	1
IIIa	4
IIIb	2
IIIc	1
IVa	9
IVb	9

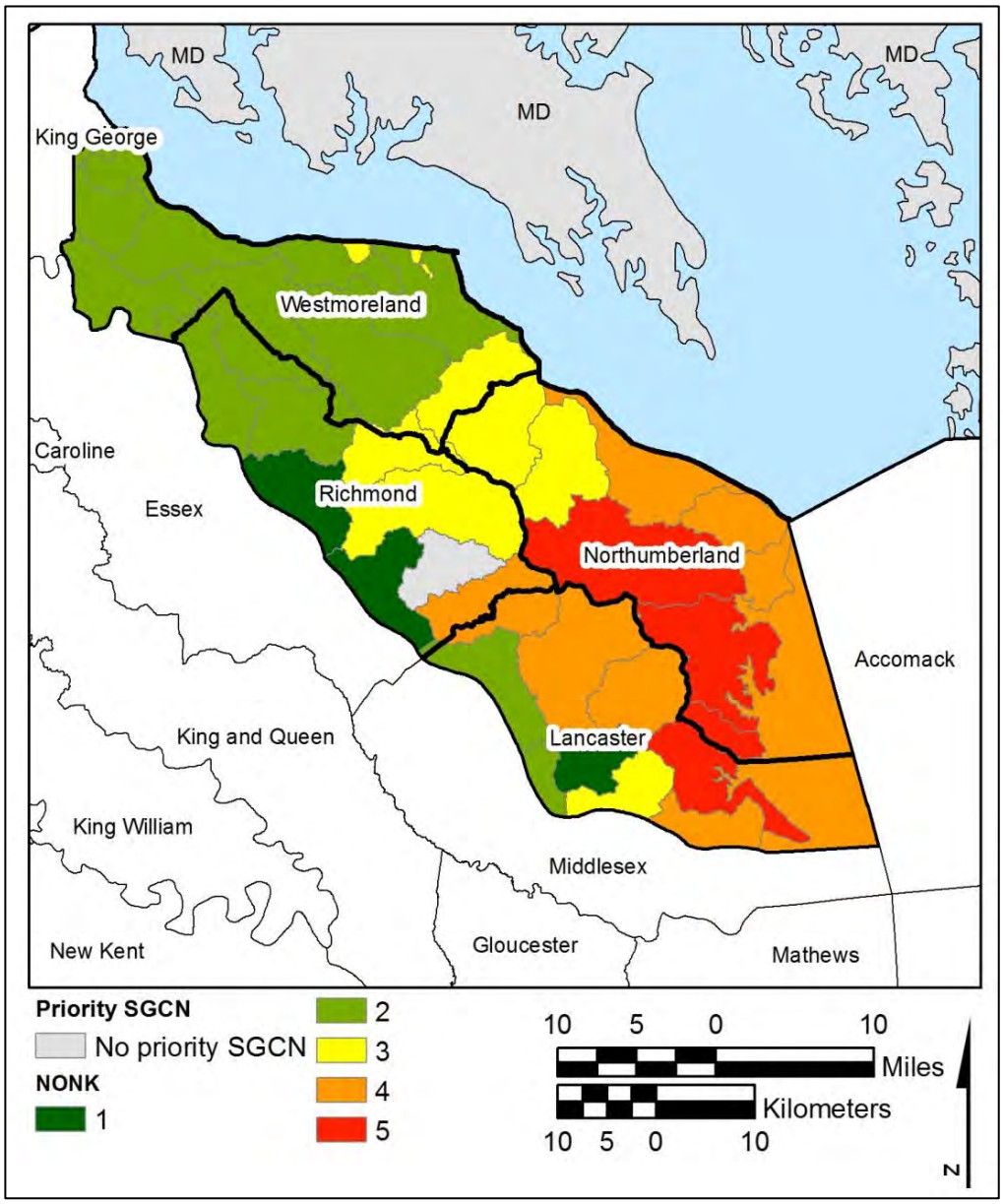

Figure 3. Priority SGCN Density in the Northern Neck Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Northern Neck Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances.
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*	Variety of marshes, swamps, and wooded streams
Bird		III	a	Brant	*Branta bernicla brota*	Saltmarshes and estuaries
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	b	Clapper rail	*Rallus longirostris*	Saltmarshes
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests

Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum pratensis*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		II	b	King rail	*Rallus elegans*	Variety of fresh water and marine marshes and wetlands
Bird		III	b	Least bittern	*Ixobrychus exilis*	Freshwater marshes
Bird		IV	b	Marsh wren	*Cistothorus palustris*	Freshwater marshes with cattails and reeds
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*	Grassy salt marshes
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitatio.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Crustacean		I	c	Lancaster County amphipod	*Crangonyx baculispina*	Site specific - non-karst subterranean - requires clean groundwater
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory – utilize variety of aquatic and marine habitats
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*	Migratory – utilize variety of aquatic and marine habitats
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	Beach obligate - does not tolerate heavy foot or vehicle traffic

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Northern Neck Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks and forests to National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Rappahannock River Valley National Wildlife Refuge,
- Westmoreland State Park,
- Belle Isle State Park,
- Caledon State Park,
- Chilton Woods State Forest,
- Hickory Hollow State Natural Area Preserve,
- Bushmill Stream State Natural Area Preserve,
- Dameron Marsh State Natural Area Preserve, and
- Hughlett Point State Natural Area Reserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

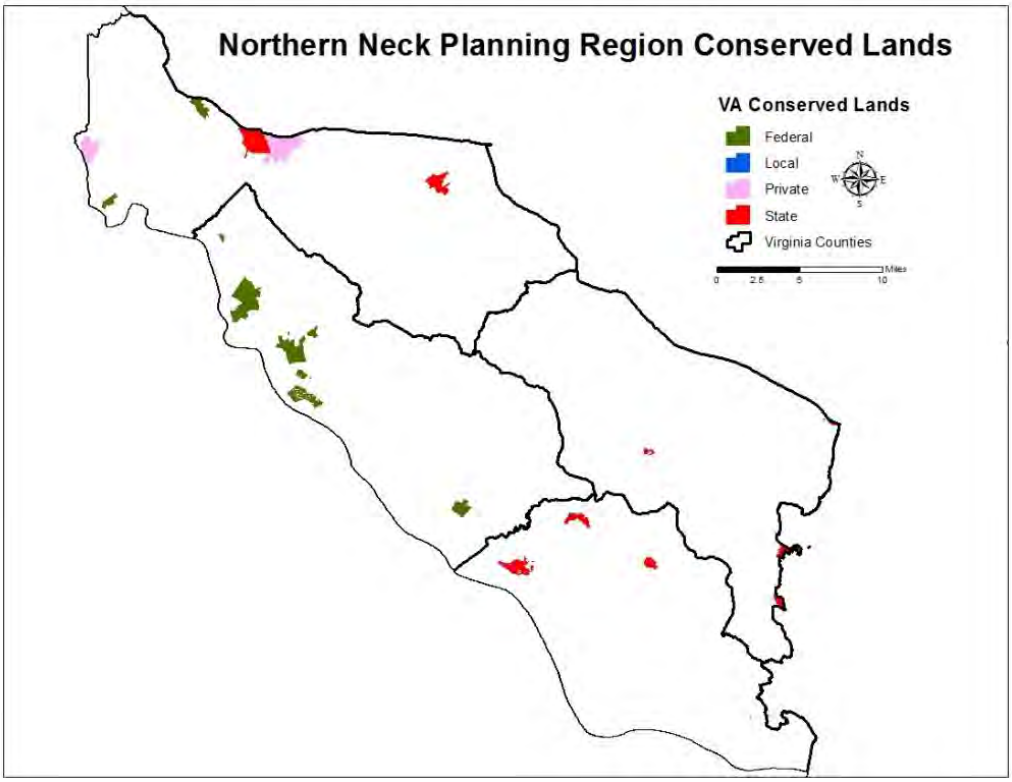

Figure 4. Conservation Lands in the Northern Neck Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts within the Northern Neck Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits to the local economy (DCR 2013; Carver and Caudill 2013). For example, in 2014 the Rappahannock River Valley National Wildlife Refuge provided approximately $100,000 in economic benefit to the local economy through visitation expenditures and employment, and tax revenues (Pers. Comm. USFWS 2015). Using estimates from Carver and Caudill, the NWR also likely provides anywhere from $700,000 to $3 million in ecosystem service benefits to the community (2013).

Climate Change Impacts in the Northern Neck Planning Region

The Northern Neck Planning Region is higher in elevation than other coastal areas in the state, and thus, has fewer areas that may be subject to impacts from sea-level rise (VIMS 2013). However, much of the area is directly on the Chesapeake Bay and is subject to erosion which could increase as storms become more intense (VIMS 2013).

Changes in temperature and precipitation will also negatively affect habitats and SCGN in the Northern Neck Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could

increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species' reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats within the Northern Neck Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Northern Neck Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for Northern Neck Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and conserve beach, dune, and mudflat habitats	1) Protect unconserved beach lands that support the Northeastern beach tiger beetle and Northern diamondback terrapin.	Land conversion/ alteration, predators	Enhanced recreational opportunities; Promote economic activity related to wildlife watching	Specific areas suitable for Northeastern beach tiger beetle or areas adjacent to habitats used by these species.
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Implement small acreage grazing systems, 2) Plant vegetative buffers on croplands, 3) Plant vegetative buffers on residential lands, 4) Implement efforts to prevent pet waste from entering streams, 5) Maintain or replace failing septic systems; 6) Continue to identify impaired waters; and 7) Monitor and address invasive species impacts.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, water withdrawals, land use conversion, invasive species, ship strikes and overfishing	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to water supply	Beach Creek, Greenvale Creek, Paynes Creek Additional areas include Cat Point Creek and Farnham Creek
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive	Land use change and conversion, non-native exotic invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

	species.			
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter river systems	Areas supporting SGCN that are not already protected

Maintain and Conserve Beach, Dune, and Mudflat Habitats

The Northern Neck Planning Region has extensive beach habitat that provide nesting habitat for the Northeastern beach tiger beetle and the diamondback terrapin. Beach, dune, and mud flat habitat make up approximately 345 acres (0.06 percent) of the planning region (Anderson et al. 2013).

Threats

Although some of the planning region's beach, dune, and mudflat habitats are protected by state and federal agencies, significant threats still exist.

1. Habitat Conversion/ Alteration: Beach, dune, and mudflat habitat in this planning region is primarily threatened by residential development. The accompanying infrastructure being built up against the dunes and beaches can destroy or alter fragile habitats. Shoreline hardening is also an issue along the beach front. Hardening prevents natural processes from occurring and can result in erosion, displacement of sediment, and loss of shoreline habitat.

2. Climate Change: Climate change, with resulting sea-level rise and more intense storm events, will likely lead to increased coastal flooding. The effects of flooding are further exacerbated by naturally occurring land subsidence. Severe storms as well as sea-level rise will also likely increase erosion and salt water intrusion along the coast into sensitive ecosystems (CCSP 2009). However, because much of the Northern Neck is at higher elevations than other coastal areas within the state, these impacts may be less severe (VIMS 2013).

Conservation Management Actions

Beaches, dunes, and mudflats are dynamic and have important habitat and economic value. Conservation actions will require the conservation community to work closely with agencies, landowners, municipalities, and elected officials to find a sustainable balance between conservation, human recreation, and economic development. Each of these entities has valid regional concerns that should be considered within the broader management context to accommodate the various interests.

Local coordination, protection, and management of beaches that support the Northeastern tiger beetle and diamondback terrapin should be pursued if not already implemented, especially in Northumberland and Lancaster counties. Additionally, predators, such as raccoons, foxes, or gulls can have a significant impact on beach nesting birds and reptiles.

Climate-Smart Management Actions

Some beach, dune, and mudflat habitats in this planning region are susceptible to sea-level rise and impacts from storms. The primary climate-smart actions to help protect beach systems include expanding coastal restoration and conservation strategies to include protecting and/ or providing habitat adjacent to and upland of these beaches. This strategy will help allow for potential inland migration of beaches. Protecting these areas can occur through acquisition or partnerships with landowners. Expanding monitoring along these areas to enable early detection and action as areas become increasingly affected by sea-level rise and storm events (Glick et al. 2008).

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Northern Neck Planning Region (Table 4). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Wetlands provide valuable habitats for the brant, black-crowned night-heron, clapper rail, king rail, seaside sparrow, and a variety of other species.

Table 4. Wetland Acreage Totals in the Northern Neck Planning Region (Anderson et al. 2013).

Wetland Type	Acres	Percent of Planning Region
Non-Tidal	33,397.66	5.98%
Tidal	19,836.21	3.55%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to tidal and non-tidal wetlands is conversion to other uses such as residential housing and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of wetland habitat through damage or loss to wetland vegetation. Mute swans out-compete native species by consuming significant amounts of emergent and submerged aquatic vegetation (DGIF 2012). Mute swans can also destroy vegetation by uprooting it, thereby limiting the effectiveness of wetland restoration (DGIF 2012). Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites*, purple loosestrife, mute swans, and exotic invertebrates.

4. Climate Change: As sea levels rise, marshes can be inundated and converted to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open water habitats and salt marshes will not support the same vegetative composition as the non-tidal

and tidal wetlands in this planning region, affecting the wildlife species that depended on these habitats. Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Northern Neck Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation could be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). Some of the highest

priority areas for conservation are along the waterfront of the Rappahannock River and Chesapeake Bay (Lancaster County). The highest priority areas for restoration are around the coastline of the planning region – on the Rappahannock, Potomac, and Chesapeake Bay.

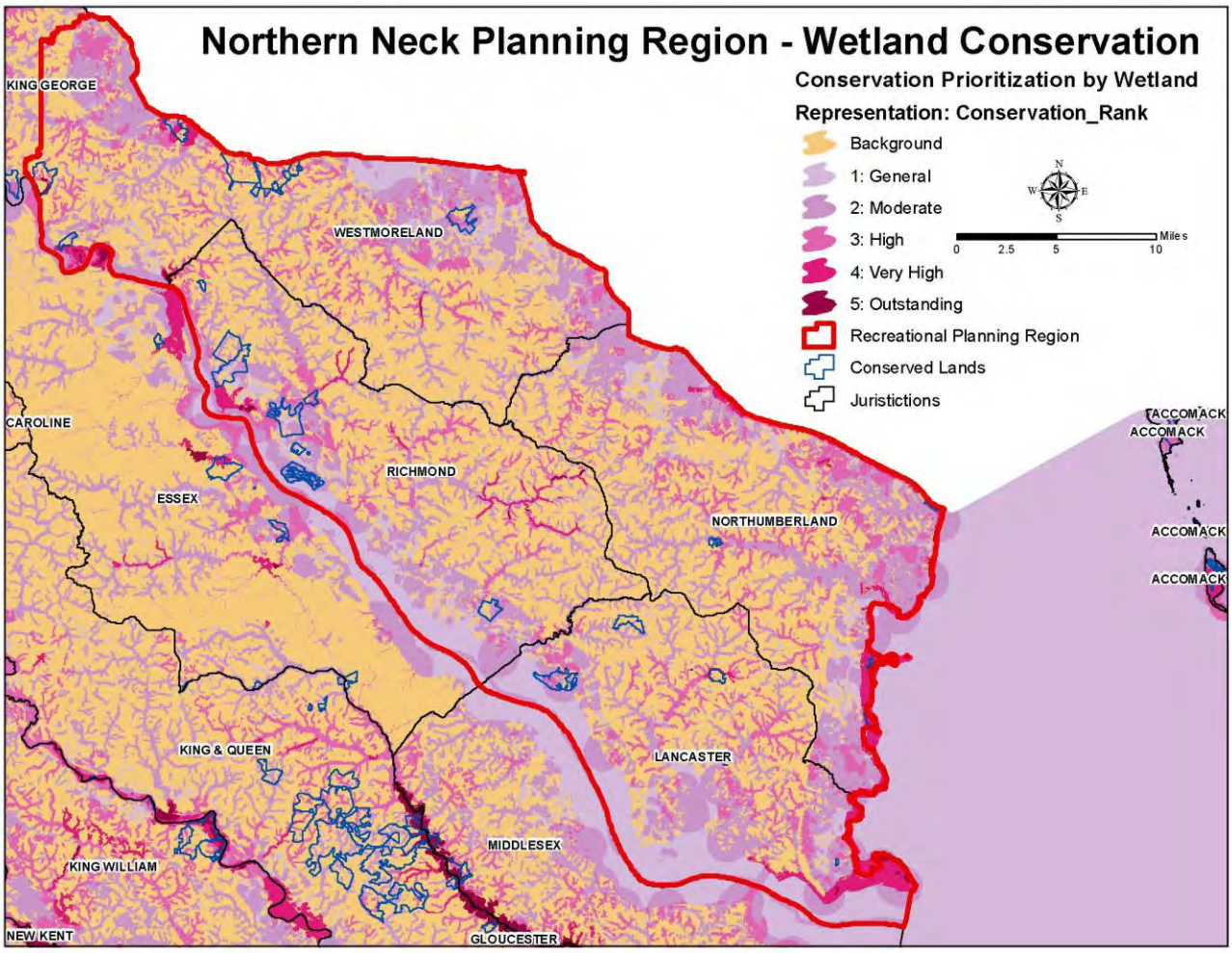

Figure 5. Wetland Conservation Priority Areas in Northern Neck Planning Region (Weber and Bulluck 2014).

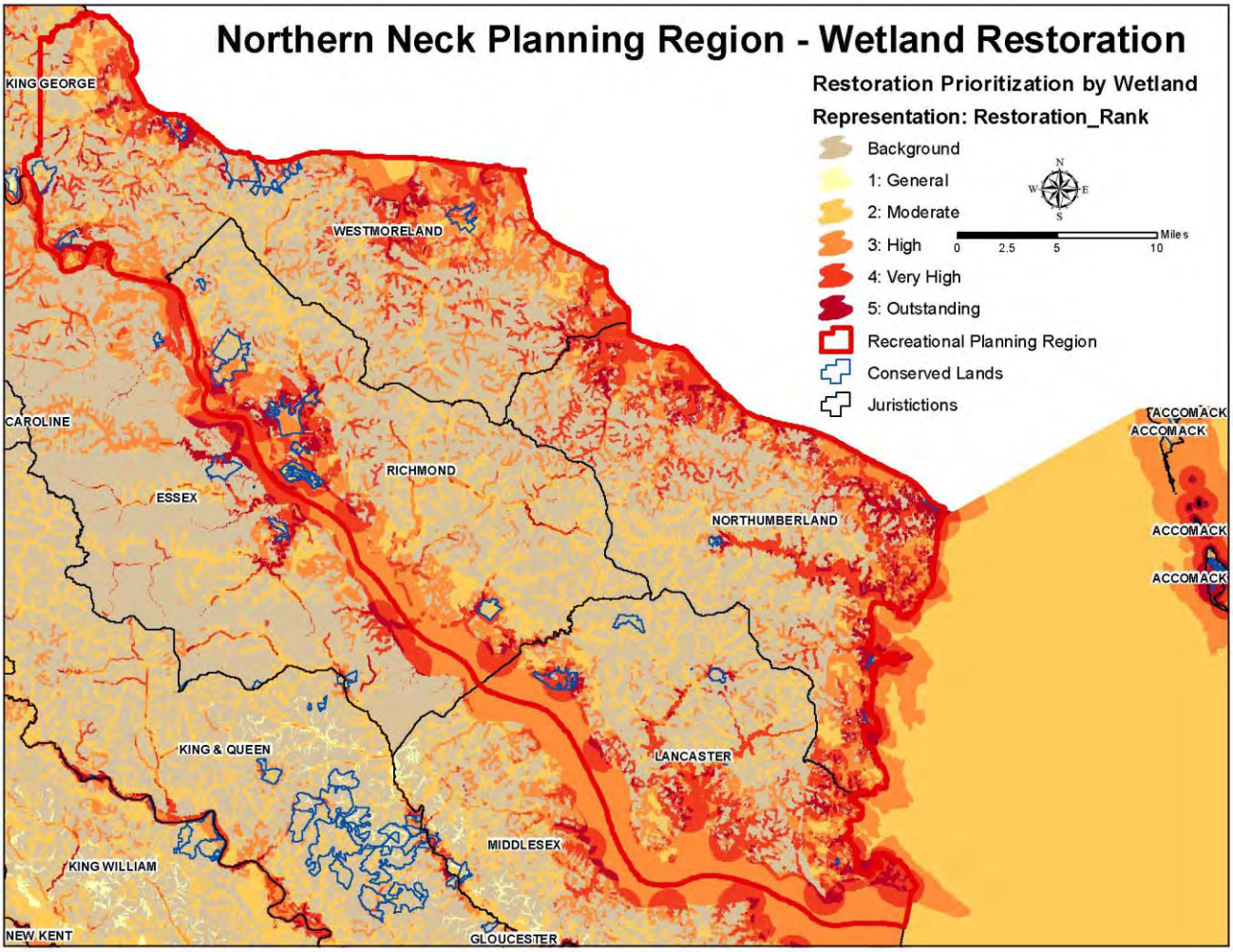

Figure 6. Wetland Restoration Priority Areas for Northern Neck Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Northern Neck Planning Region include tidally influenced rivers, streams, and creeks. River systems include the Rappahannock and Potomac as well as smaller streams and creeks. Approximately 83,600 acres (15 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and

invertebrates. Examples of priority SGCN that depend on these aquatic systems include Atlantic and shortnose sturgeons and Lancaster County Amphipod.

Threats

Aquatic and riparian habitats within the Northern Neck Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Northern Neck Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. The Northern Neck Planning Region has a low percentage of impervious surface cover; however, there are some with impervious surfaces (Figure 7).

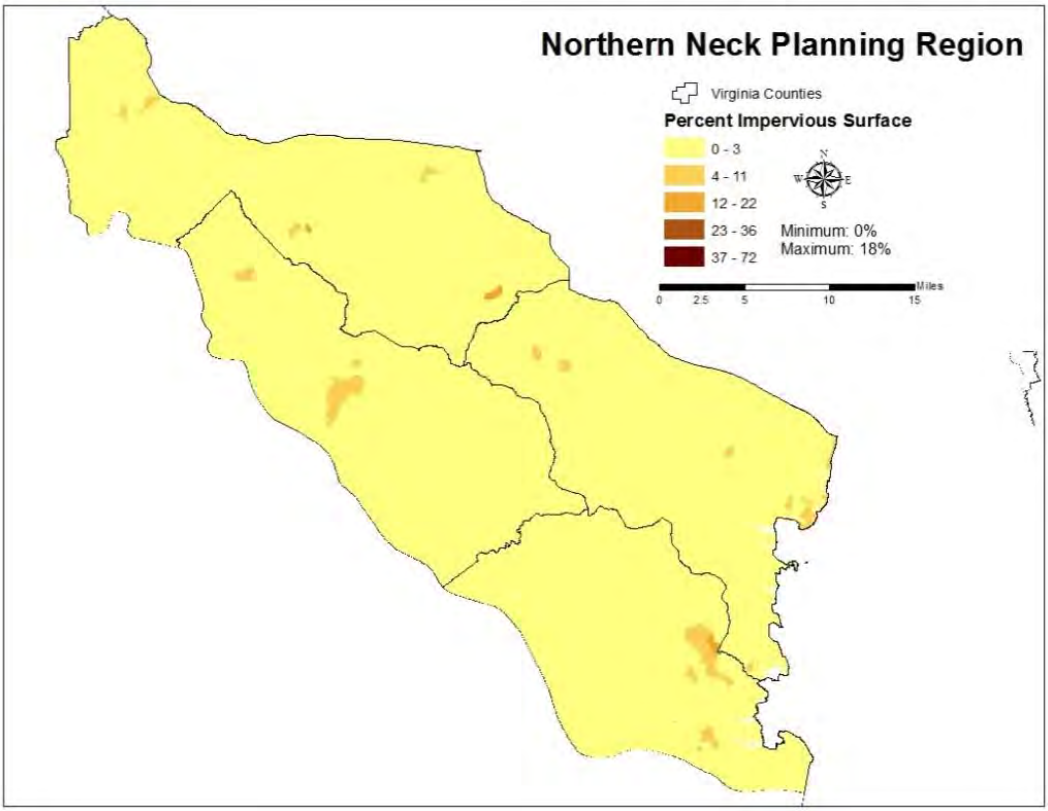

Figure 7. Impervious Surface Cover in Northern Neck Planning Region (SARP 2014).

3. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the aquifer that could degrade the quality of both subterranean and surface water.

4. Invasive Species: Additional threats to aquatic systems within Northern Neck Planning Region include aquatic invasive species such as blue catfish, snakeheads, Asian carp (e.g., big head carp and grass carp) that either consume native species or consume aquatic vegetation as well as those that impair waterways, thereby altering the quality of these aquatic habitats.

5. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Sea-level rise could result in inundation of shoreline, while changes in temperature and

precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Beach Creek, Greenvale Creek, and Paynes Creek (DCR 2009) (Figure 8).

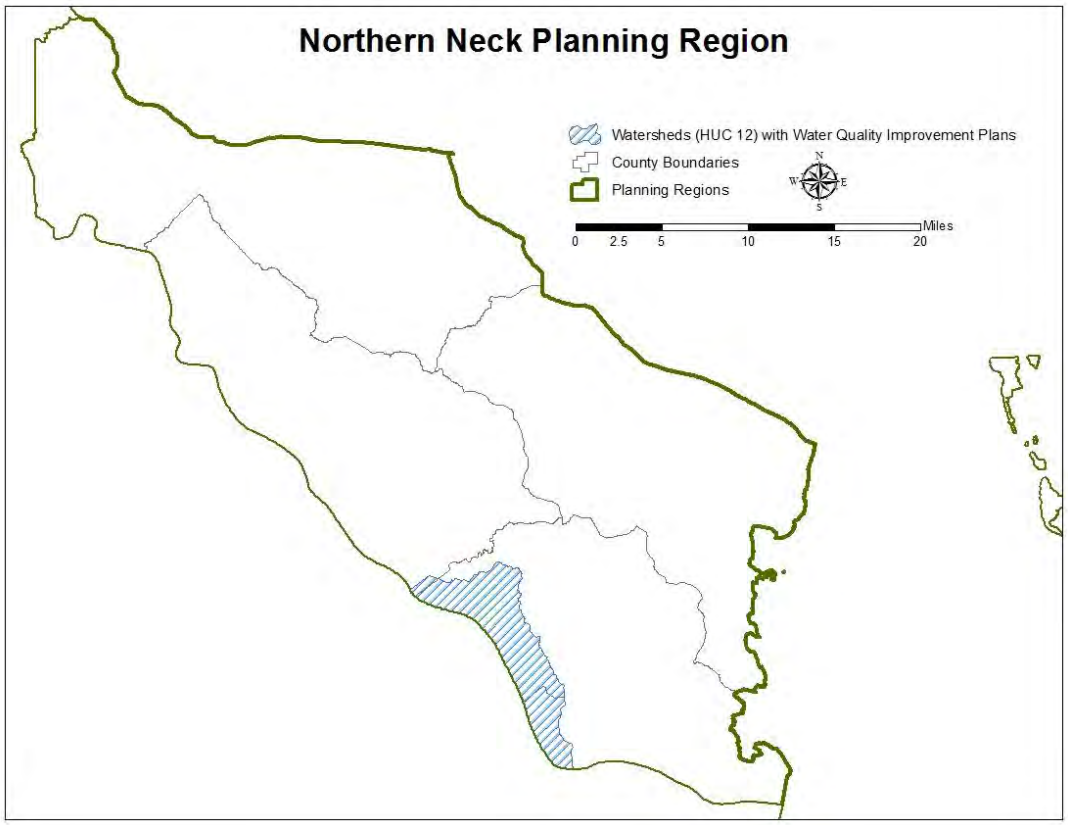

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality in these watersheds include:

- Implementing small acreage grazing systems,
- Planting vegetative buffers on croplands,
- Planting vegetative buffers on residential lands,
- Implementing efforts to prevent pet waste from entering streams, and
- Maintaining or replacing failing septic systems.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity

Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

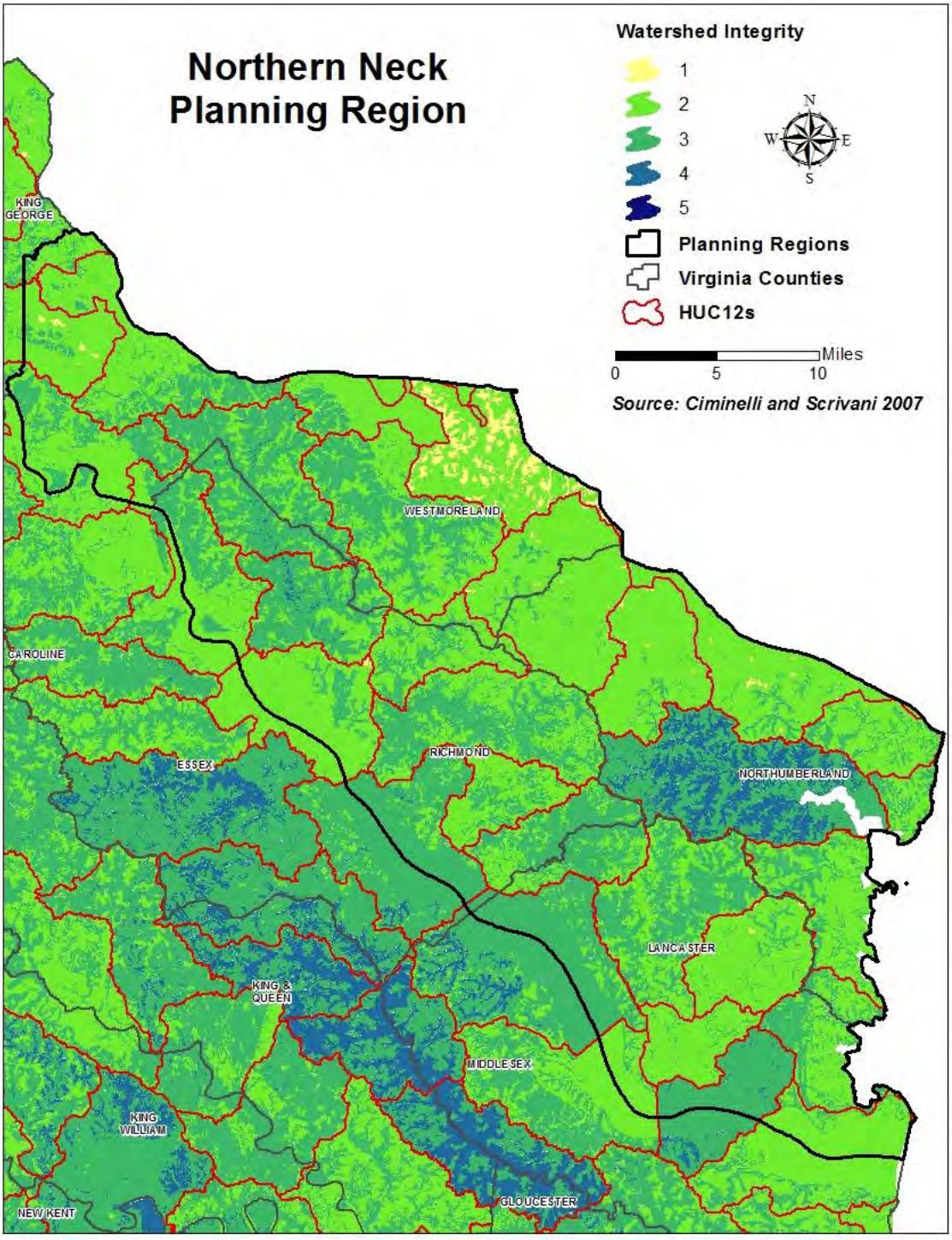

Figure 9. Watershed Integrity Model for Northern Neck Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Northern Neck Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Northern Neck Planning Region include: monitoring and addressing invasive species impacts as well as promoting efforts to rinse boats and trailers on site and considering land acquisitions or easements that will help protect the land surrounding creeks.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, also could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make almost half of the Northern Neck Planning Region and are important for a broad range of species (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the Eastern whip-poor-will, Eastern wood-pewee, northern flicker, and wood thrush.

Table 5. Forest Acreage Totals in Northern Neck Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	243,280.71	43.53%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Northern Neck Planning Region is fragmentation, mainly due to residential development and resulting roads and infrastructure. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species such as privet and Japanese stilt grass and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Northern Neck Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their

native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

Several agencies, including DGIF, NRCS, DOF, USFWS, and the U.S. Forest Service (USFS) advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Climate-Smart Management Actions

To best manage forests in the Northern Neck Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 32,000 acres (2.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than three percent), these habitats are important for priority SGCN, including the tawny crescent and Persius duskywing butterfly.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2008). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2008). The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more prone to drought. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2013). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2013). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Northern Neck Planning Region, priority conservation opportunities include:

- Protecting beaches, dunes, and mud flats;
- Protecting and restoring tidal and non-tidal wetlands;
- Improving the quantity and quality of water in creeks and rivers through best management practices and water quality improvement mechanisms; and
- Conserving tracts of mature hardwood forests.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN NORTHERN NECK PLANNING REGION

Complete SGCN list for the Northern Neck Planning Region (SGCN=65). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Brant	*Branta bernicla*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird	**SE**	I	a	Black rail	*Laterallus jamaicensis*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	b	Clapper rail	*Rallus longirostris*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*

Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		II	b	King rail	*Rallus elegans*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		IV	a	Marbled godwit	*Limosa fedoa*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	b	Nelson's sparrow	*Ammodramus nelsoni*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		IV	c	Purple sandpiper	*Calidris maritima*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		III	a	Saltmarsh sparrow	*Ammodramus caudacutus*
Bird		IV	b	Seaside sparrow	*Ammodramus maritimus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean		I	c	Lancaster County amphipod	*Crangonyx baculispina*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		IV	c	Common ribbonsnake	*Thamnophis sauritus sauritus*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish	**FESE**	I	a	Shortnose sturgeon	*Acipenser brevirostrum*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
Insect	**FTST**	II	a	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*
Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile	**FTST**	I	a	Loggerhead sea turtle	*Caretta caretta*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

17. Northern Shenandoah Valley Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and are found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

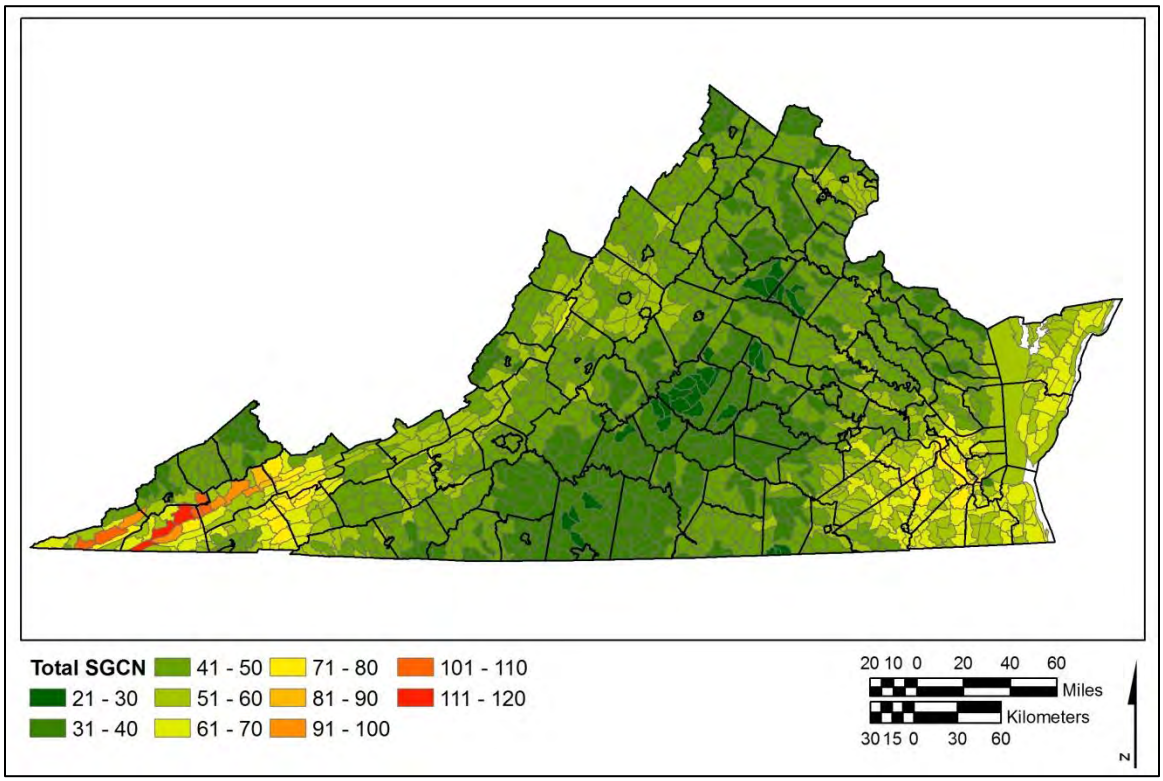

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

NORTHERN SHENANDOAH VALLEY PLANNING REGION SUMMARY OVERVIEW

The Northern Shenandoah Valley Planning Region consists of 1,054,305 acres (1,647 square miles). It includes the counties of Clarke, Frederick, Page, Shenandoah, and Warren; city of Winchester; and towns of Front Royal, Luray, Middeltown, Stephens City, and Strasburg. The human population in this planning region is estimated to be almost 231,000 people (US Census Bureau 2015). Population growth rates have varied since 2000, but they have been increasing in all the counties (DCR 2013a).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including the eight species that occur only within this region and nowhere else in the world. They include the Luray Caverns amphipod, Hubbard's cave beetle, mud-dwelling cave beetle, Petrunkevitch's cave beetle, thin-neck cave beetle, cave pseudoscorpion, fisher, and Appalachian cave springsnail. The planning region has a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

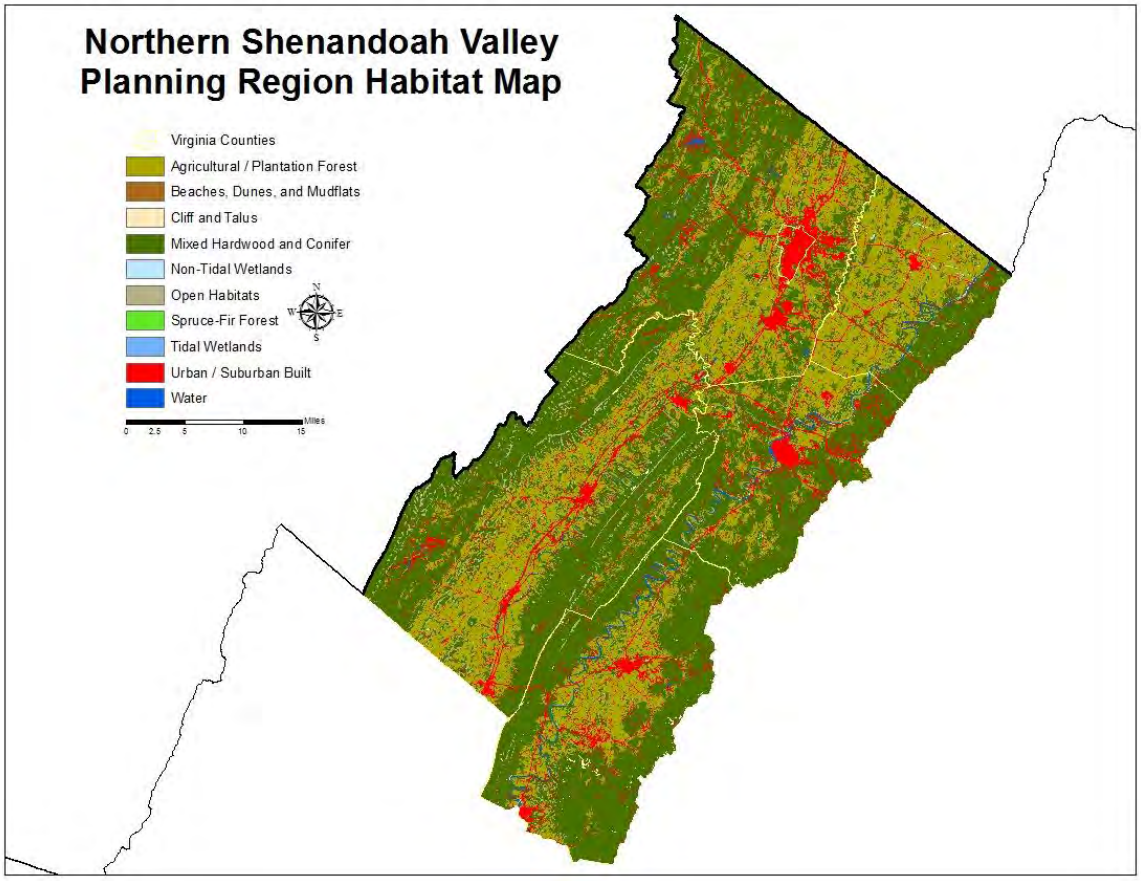

Figure 2. Northern Shenandoah Valley Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 90 are believed to either occur, or have recently occurred, within the Northern Shenandoah Valley Planning Region (Appendix A). Of these 91 species, ***57 SGCN are dependent upon habitats provided within the Northern Shenandoah Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 56 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	5
Ib	1
Ic	3
IIa	2
IIb	2
IIc	11
IIIa	5
IIIb	1
IIIc	5
IVa	12
IVb	7
IVc	3

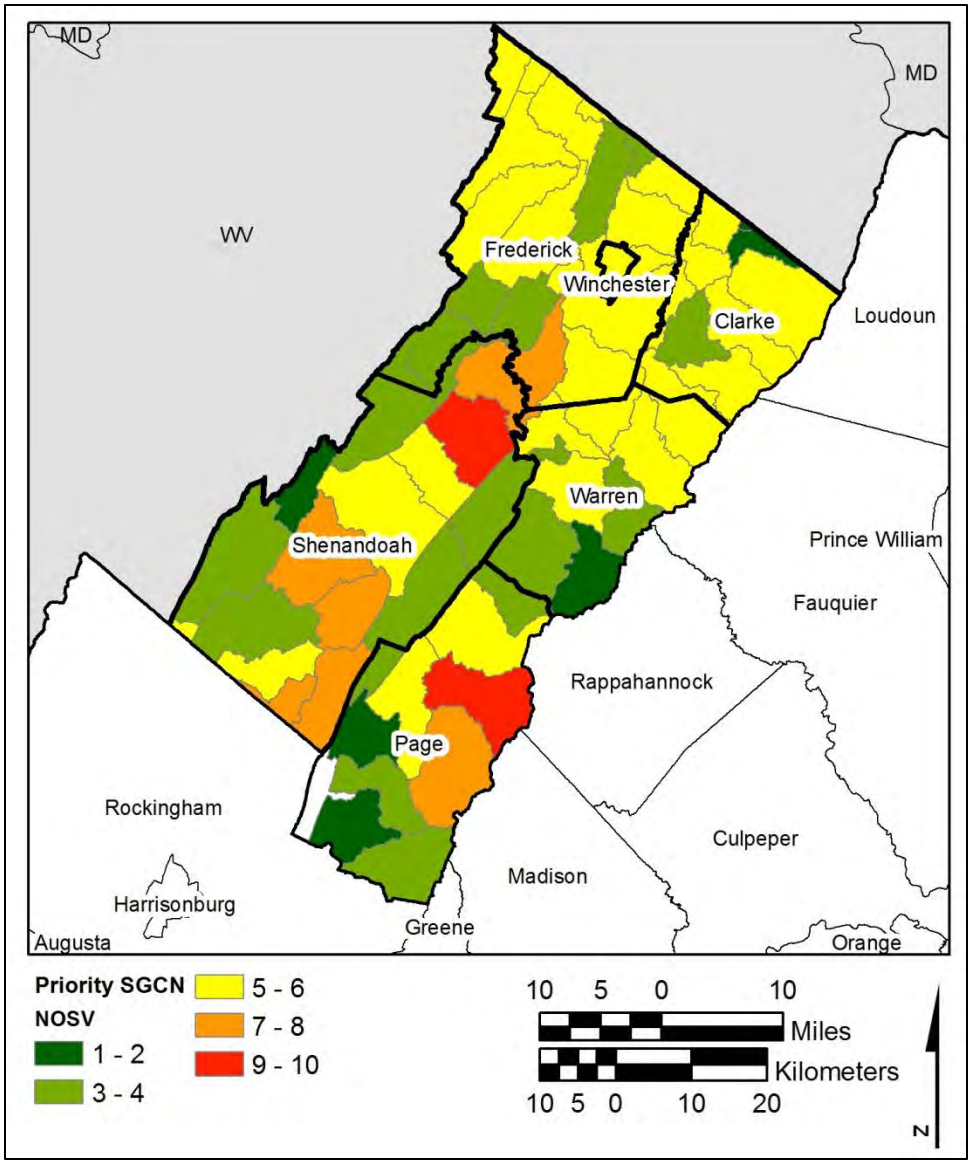

Figure 3. Priority SGCN Density in the Northern Shenandoah Valley Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Northern Shenandoah Valley Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		I	c	Cow Knob salamander	*Plethodon punctatus*	Site specific - mixed hardwood forests in rocky areas in high elevations
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*	West of Shenandoah River - high elevation hardwood forests
Amphibian		III	c	Shenandoah Mountain salamander	*Plethodon virginia*	Site specific - deciduous hardwood forests on mountain slopes and ravines in western Rockingham County
Amphibian	**FESE**	I	c	Shenandoah salamander	*Plethodon shenandoah*	Handful of sites in Shenandoah National Park
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites

Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River
Bird		III	c	Red crossbill	*Loxia curvirostra*	Spruce-fir or hemlock forests above 4000 feet

Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*	Clean flowing streams with rocky substrates
Crustacean	**FS**	II	b	Luray Caverns amphipod	*Stygobromus pseudospinosus*	Caves with clean abundant water flowing through the system
Crustacean	**FTST**	II	c	Madison Cave isopod	*Antrolana lira*	Caves with clean abundant water flowing through the system
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*	Pools of small creeks and rivers with sand or gravel substrate
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish		IV	c	Slimy sculpin	*Cottus cognatus*	Spring fed cold water streams
FW Mollusk	**FSSE**	II	c	Appalachian springsnail	*Fontigens bottimeri*	Individual springs in Frederick county
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*	Springs and cave streams in the Potomac basin and along the Blue Ridge
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*	Clear flowing water with sand or gravel substrates
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*	Either flowing or standing water with gravel, sand, silt, or mud substrates
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*	Large streams and rivers with low gradient and sand and gravel substrates
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil

Insect	**FS**	II	c	Avernus cave beetle	*Pseudanophthalmus avernus*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Hubbard's cave beetle	*Pseudanophthalmus hubbardi*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Mud-dwelling cave beetle	*Pseudanophthalmus limicola*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Petrunkevitch's cave beetle	*Pseudanophthalmus petrunkevitchi*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*	Dry habitats including clearings, open woods and roadsides containing wavy-leaved asters
Insect	**FS**	II	c	Thin-neck cave beetle	*Pseudanophthalmus parvicollis*	Caves with clean abundant water flowing through the system
Mammal		II	c	Fisher	*Martes pennanti pennanti*	Spruce-fir forests, northern bogs and swamps, or mixed hardwood trees
Mammal	**FE**	I	a	Indiana Bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing dead exfoliating trees.
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Mundochthonius holsingeri*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Chitrella superba*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate		III	c	Depressed glyph	*Glyphyalinia virginica*	No habitats have been identified for this terrestrial snail
Other Terrestrial Invertebrate		IV	c	Ribbed striate	*Striatura exigua*	No habitats have been identified for this terrestrial snail
Other Terrestrial Invertebrate		III	c	Variable mantleslug	*Pallifera varia*	Moist forest habitats
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*	Clear streams with adjacent riparian forests and fields

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

CONSERVED LANDS IN THE NORTHERN SHENANDOAH VALLEY PLANNING REGION

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national forests and parks to state parks and forests to conservation easements. Significant conservation assets, in terms of size, include:

- George Washington National Forest,
- Shenandoah National Park,
- Cedar Creek and Belle Grove National Historic Park,
- Appalachian Trail,
- Skyline Drive,
- Andy Guest/Shenandoah River State Park,
- Seven Bends State Park, and
- Devil's Backbone State Forest.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

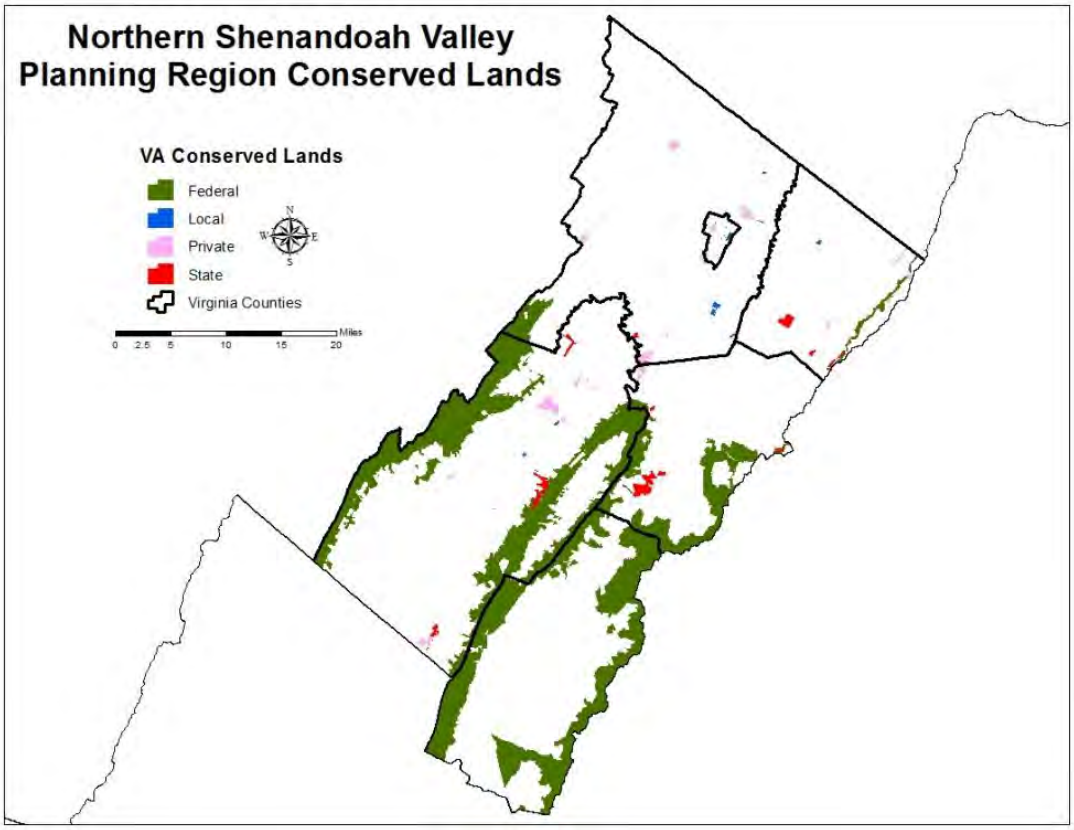

Figure 4. Conservation Lands in the Northern Shenandoah Valley Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Northern Shenandoah Valley Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. There may be concern over the economic and social impacts of putting more lands into conservation, but many of these areas provide recreation and ecotourism benefits (DCR 2013a; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Northern Shenandoah Valley Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the Northern Shenandoah Valley Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the mountains than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Pepin 2015; Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson, 2011; Kane, 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al., 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke, et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions to Wildlife and Habitats in the Northern Shenandoah Valley Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many of the Northern Shenandoah Valley Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Northern Shenandoah Valley Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better control fecal matter and sewage.	Increasing industrial/residential water consumption, sedimentation and pollutants, protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetative and/ or forested buffers along streams and sinkholes as well as in agricultural, urban and residential areas; 2) Restore/ stabilize eroding stream banks; 3) Reclaim/revegetate disturbed forest lands; 4) Exclude livestock from streams; 5) Improve pasture and loafing lot management to prevent manure-tainted runoff from flowing into streams; 6) Repair or replace failing septic systems and eliminating "straight pipes;" 7) Implement urban storm water management BMPs; 8) Restore/reclaim abandoned mine lands; 9) Prevent pet waste from entering streams; 10) Continue to identify impaired waters within the planning region; 11) Restore aquatic connections; 12) Monitor and address invasive species impacts; and 13) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities	Abrams Creek, Lower Opequon Creek, Upper Opequon Creek, Hawksbill Creek, Mill Creek, Holman's Creek, Page Brook, Roseville Run, Spout Run, Smith Creek
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

	viability; and 5) Monitor and control invasive species.			
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Northern Shenandoah Valley Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for many SGCN, including the Luray Caverns amphipod, Hubbard's cave beetle, thin-neck cave beetle, mud-dwelling cave beetle, and a wide variety other important species.

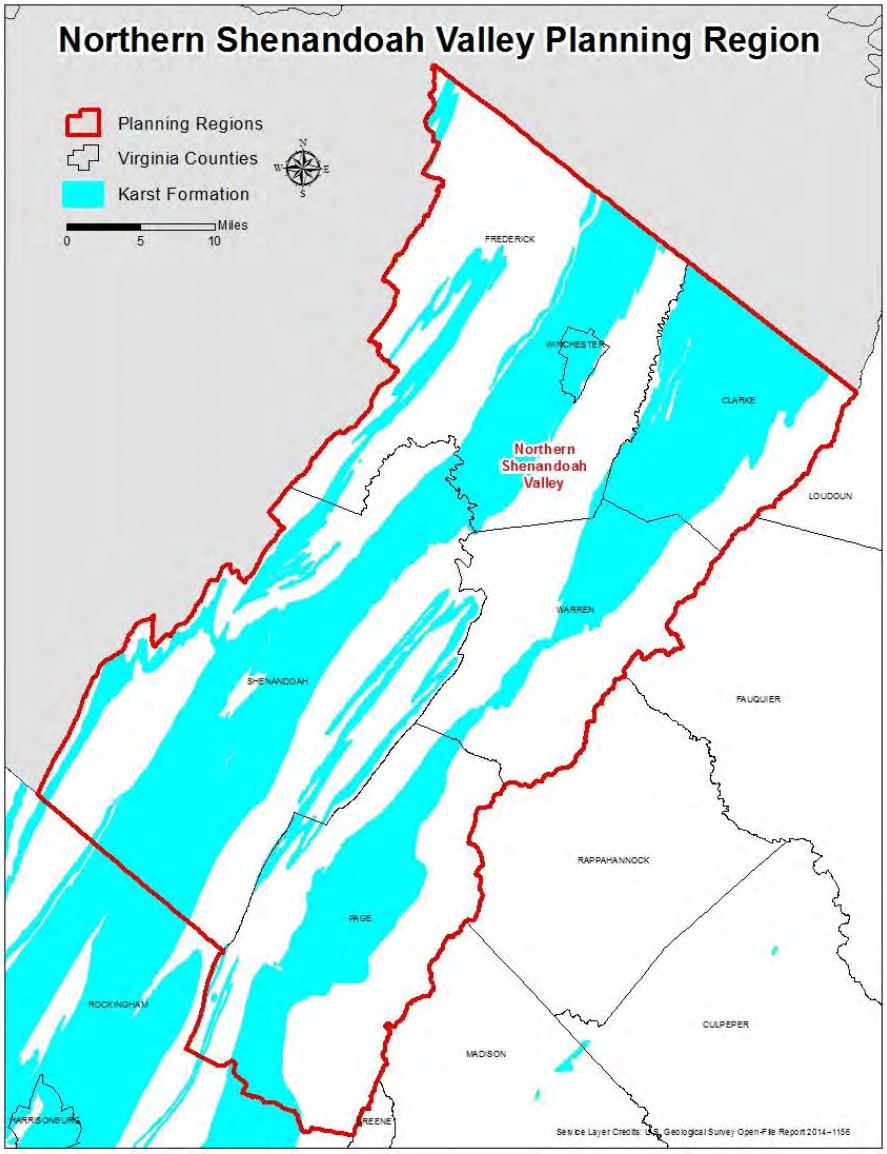

Figure 5. Karst Areas in the Northern Shenandoah Valley Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems is affected by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, and adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites. Development and resulting pollutant-laden runoff also negatively affect water quality (DCR 2008).

2. Altered Hydrology: Development, which also likely plays a role in degraded water quality in the areas where karst occurs, can also result in altered hydrology which can affect water quantity and flows. The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change as with increased storm intensity will result in more stormwater runoff.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Northern Shenandoah Valley Planning Region include cold and warm water rivers, streams, and creeks. The majority of the planning region falls within the Shenandoah River watershed. Approximately 9,780 acres (0.9 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the Appalachian springsnail, pearl dace, brook floater, depressed glyph, and yellow lampmussel.

Threats

Aquatic and riparian habitats within the Northern Shenandoah Valley Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Northern Shenandoah Valley Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in

hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although the Northern Shenandoah Valley Planning Region has some watersheds with a high percentage of impervious surface cover, the majority of the planning region has a low percentage of impervious surface cover (Figure 6).

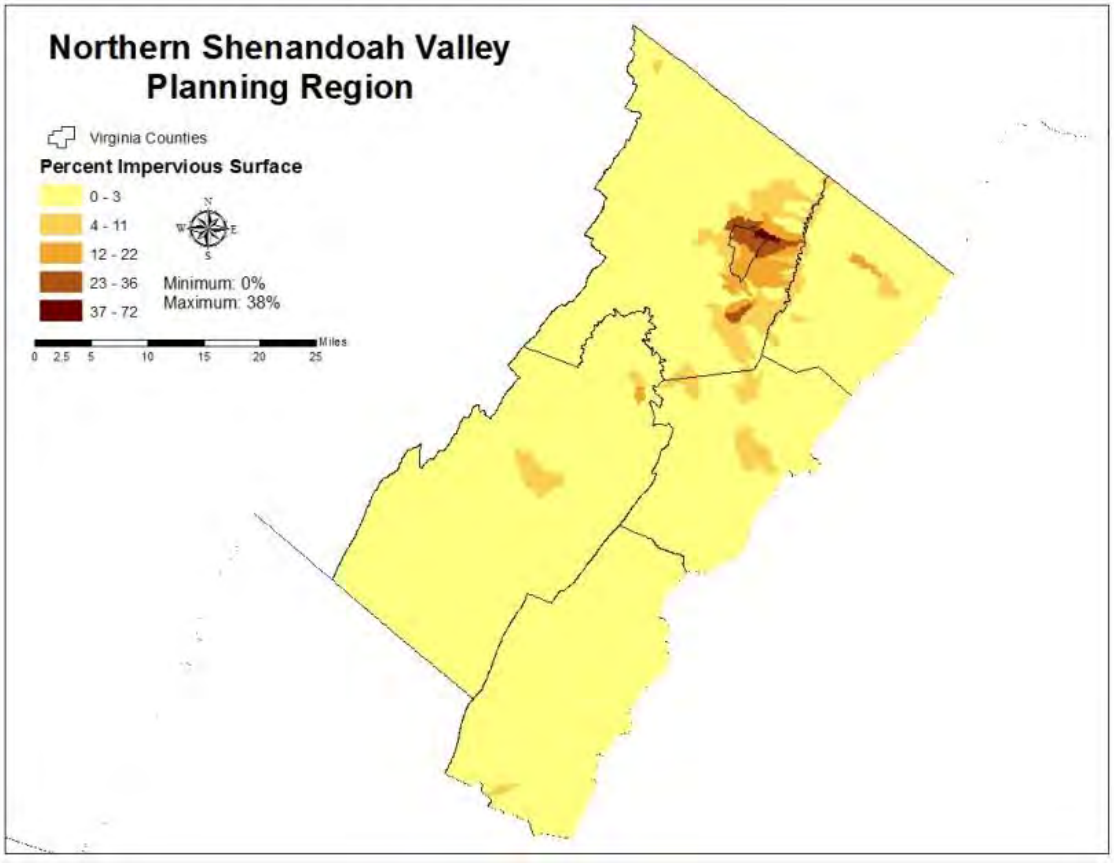

Figure 6. Impervious Surface Cover in Northern Shenandoah Valley Planning Region (SARP 2014).

3. Catastrophic Spills: Catastrophic spills from industrial sites or road crossings can result in extensive loss of species and habitat in a short time period.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation

by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

6. Stream Acidification: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014).

7. Climate Change: Climate change will also affect both warm and coldwater streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Abrams Creek, Lower Opequon Creek, and Upper Opequon Creek (Opequon Creek IP Steering Committee 2006); Hawksbill Creek and Mill Creek (MapTech 2007); Holman's Creek (Holman's Creek Citizens Watershed Committee and DCR 2002); Page Brook, Roseville Run, and Spout Run (DCR 2013b); and Smith Creek (Virginia Tech 2009) (Figure 7).

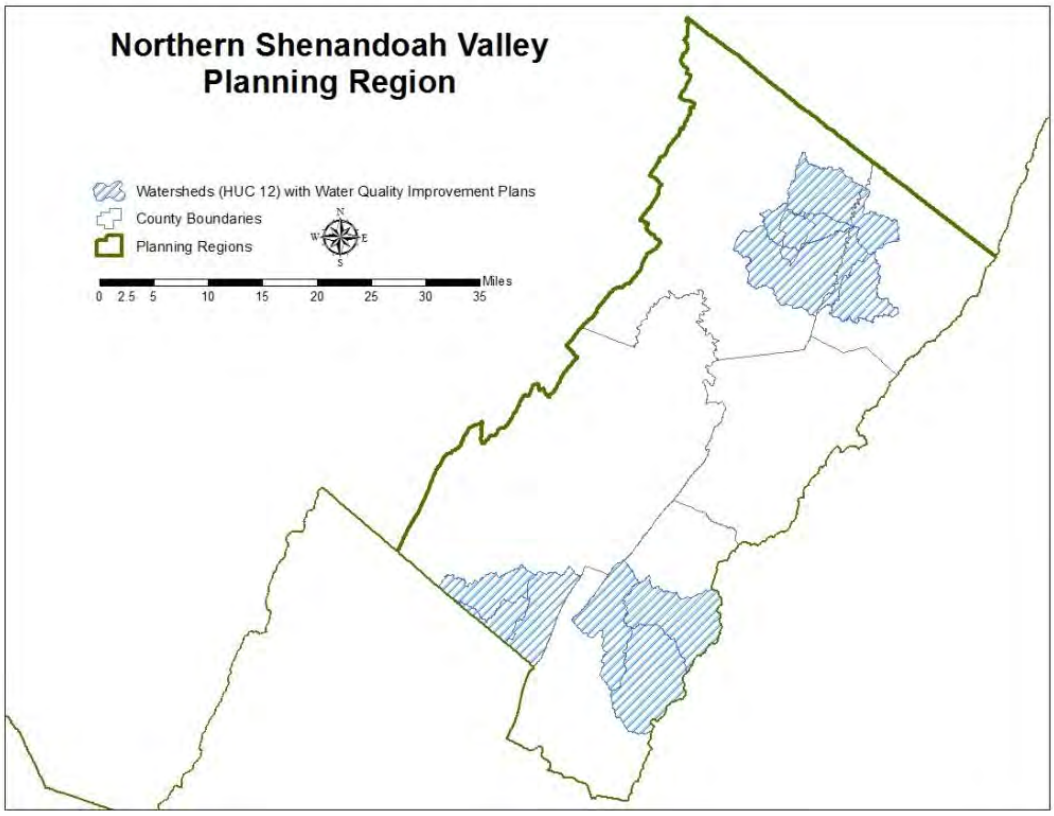

Figure 7. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetative and/ or forested buffers along streams and sinkholes as well as in agricultural, urban and residential areas;
- Restoring/stabilizing eroding stream banks;
- Reclaiming/revegetating disturbed forest lands;
- Excluding livestock from streams;
- Improving pasture and loafing lot management to prevent manure-tainted runoff from flowing into streams;
- Repairing or replacing failing septic systems and eliminating “straight pipes” discharging human waste into streams;
- Implementing storm water management BMPs;
- Restoring/reclaiming abandoned mine lands; and
- Preventing pet waste from entering streams.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 8).

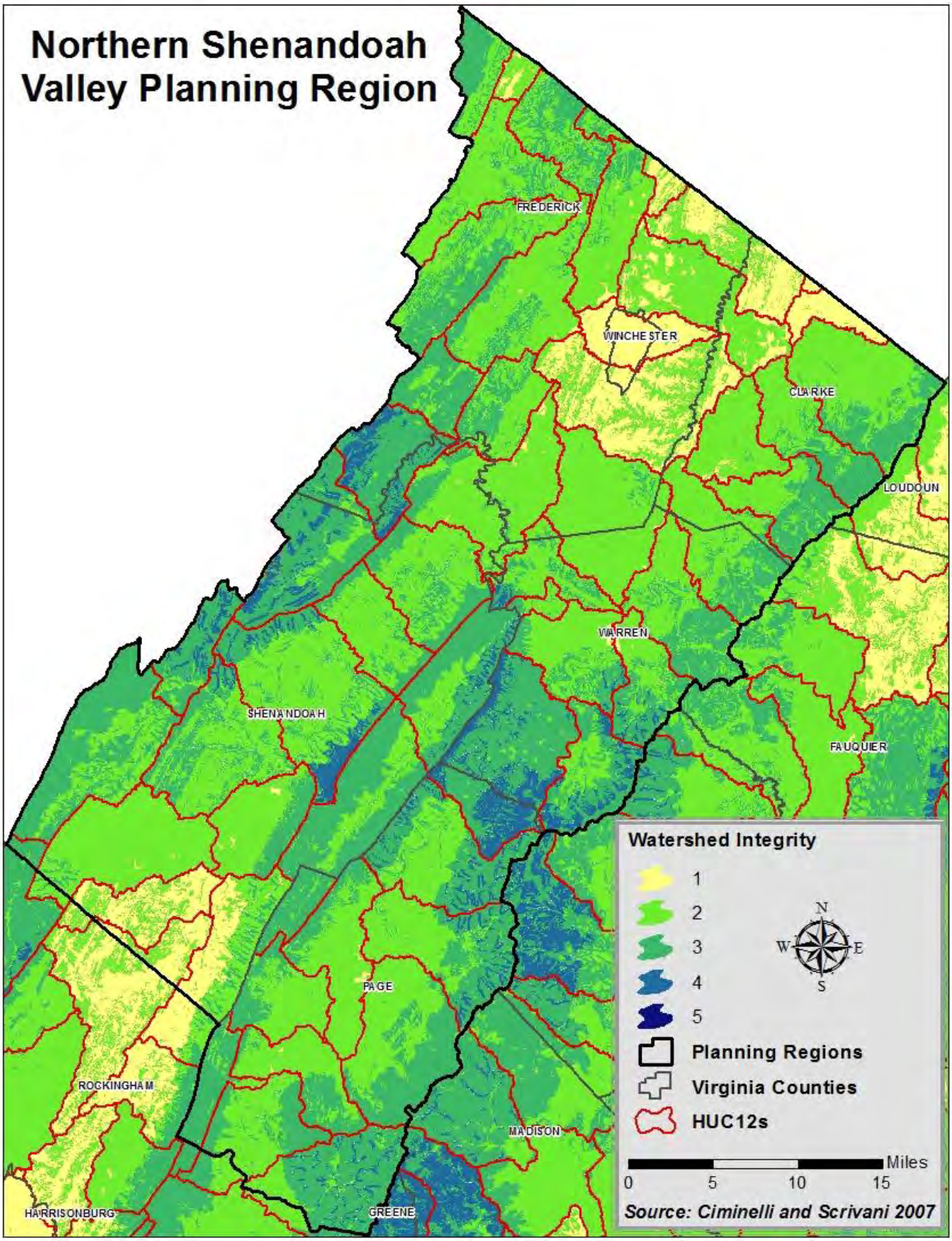

Figure 8. Watershed Integrity Model for Northern Shenandoah Valley Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Northern Shenandoah Valley Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Northern Shenandoah Valley Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up over half of the Northern Shenandoah Valley Planning Region and are important for a broad range of species (Table 4). Young forest habitat can loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. These forests help protect water resources within the region and provide habitat for species such as the cerulean warbler, red crossbill, Northern flicker, Northern saw-whet owl, wood turtle, Shenandoah salamander, and ribbed striate snail, among other species.

Table 4. Forest Acreage Totals in the Northern Shenandoah Valley Planning Region (Anderson et al. 2013.

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	591,821.53	56.16%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Northern Shenandoah Valley Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Mining and other extractive uses could also degrade habitat and affect species composition and water quality.

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the hemlock wooly adelgid. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

4. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates deer populations in the Northern Shenandoah Valley Planning Region need to be reduced in order to meet a variety of social and ecological goals (DGIF 2015a). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. Deer overbrowse can facilitate colonization by

invasive species such as privet or Japanese stilt grass. These species are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

5. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the Northern Shenandoah Valley Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Several agencies, including DGIF, NRCS, DOF, and the U.S. Forest Service (USFS) advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Reed Creek Watershed TMDL Implementation Plan Technical Report* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Reed Creek watershed to help decrease sediment run off as well as provide wildlife habitat (DEQ 2012). Similar actions are recommended for the Middle Fork Holston River and Wolf Creek watersheds (DCR 2013).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works

with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times within Virginia's current Deer Management Plan and will be similarly addressed in the revised 2015-2024 Deer Management Plan (DGIF 2015a). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Northern Shenandoah Valley Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for action plan species. Open habitats are often comprised of post-agricultural lands, glades, and barrens and make up approximately 23,750 acres (2.25 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These areas provide habitat for the loggerhead shrike, grasshopper sparrow, barn owl, and Appalachian grizzled skipper, among other species.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015b). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Many glade habitats occur within this planning region on both public and private lands. Conserving these habitats will require with willing landowners or agency managers to control invasive species, maintain the vegetative communities with fire, and managing the recreations uses of these areas to prevent the unique plant communities from being trampled.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

Conclusion

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the

enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Northern Shenandoah Valley Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN NORTHERN SHENANDOAH VALLEY PLANNING REGION

Complete SGCN list for the Northern Shenandoah Valley Planning Region (SGCN=90). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		I	c	Cow Knob salamander	*Plethodon punctatus*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		III	c	Shenandoah Mountain salamander	*Plethodon virginia*
Amphibian	**FESE**	I	c	Shenandoah salamander	*Plethodon shenandoah*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup (winter)	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird	**ST**	I	a	Henslow's sparrow	*Ammodramus henslowii*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*

Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	c	Red crossbill	*Loxia curvirostra*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*
Crustacean	**FS**	II	b	Luray Caverns amphipod	*Stygobromus pseudospinosus*
Crustacean	**FTST**	II	c	Madison Cave isopod	*Antrolana lira*
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Slimy sculpin	*Cottus cognatus*
FW Mollusk	**FSSE**	II	c	Appalachian springsnail	*Fontigens bottimeri*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	II	c	Avernus cave beetle	*Pseudanophthalmus avernus*
Insect		III	c	Depressed glyph	*Glyphyalinia virginica*
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*
Insect	**FS**	II	c	Hubbard's cave beetle	*Pseudanophthalmus hubbardi*
Insect	**FS**	II	c	Mud-dwelling cave beetle	*Pseudanophthalmus limicola*

Insect	**FS**	II	c	Petrunkevitch's cave beetle	*Pseudanophthalmus petrunkevitchi*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect		IV	c	Ribbed striate	*Striatura exigua*
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*
Insect	**FS**	II	c	Thin-neck cave beetle	*Pseudanophthalmus parvicollis*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal		II	c	Fisher	*Martes pennanti pennanti*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Terrestrial Invertebrates	**FS**	II	c	A cave pseudoscorpion	*Mundochthonius holsingeri*
Other Terrestrial Invertebrates	**FS**	II	c	Cave pseudoscorpion	*Chitrella superba*
Other Terrestrial Invertebrates		III	c	Variable mantleslug	*Pallifera varia*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

18. Northern Virginia Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Action Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN in the Plan are listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

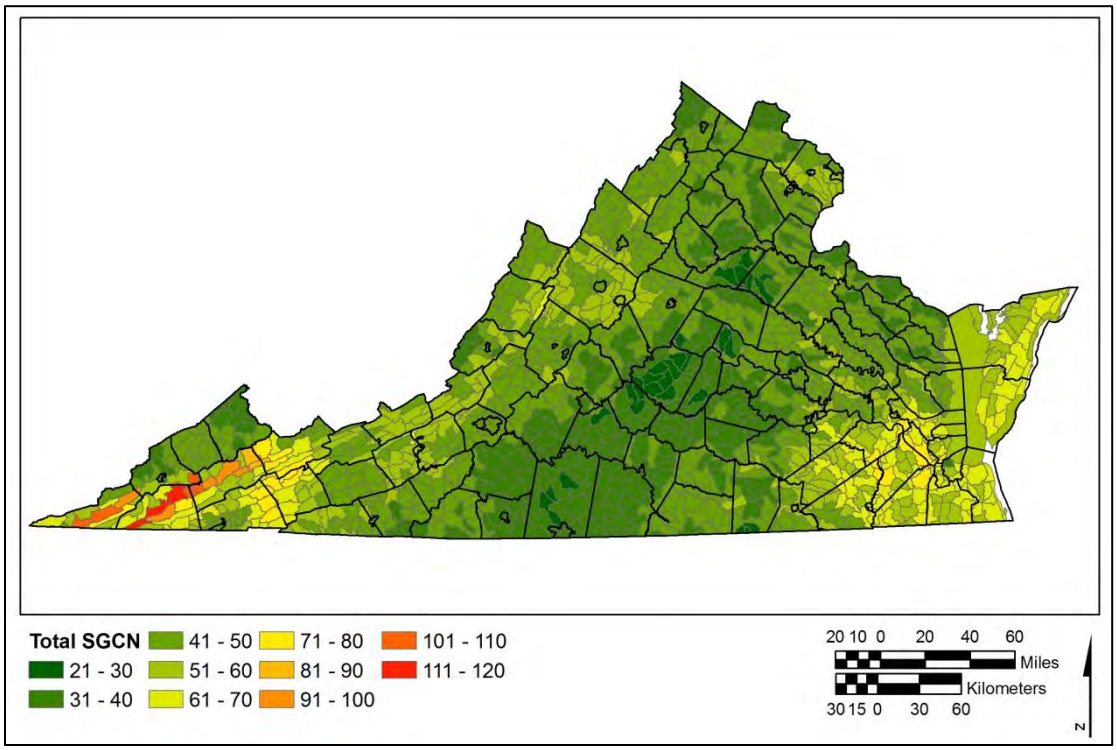

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan (DCR 2012). The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

NORTHERN VIRGINIA PLANNING REGION OVERVIEW

The Northern Virginia Planning Region consists of 857,914 acres (1,340 square miles) and includes the counties of Arlington, Fairfax, Loudoun, and Prince William, cities of Alexandria, Fairfax, Falls Church, Manassas, and Manassas Park, and towns of Dumfries, Herndon, Leesburg, Purcellville, and Vienna. The Northern Virginia Planning Region is considered part of the Washington, D.C. metro area. Approximately 35 percent of the planning region is urban (DGIF 2014; Anderson et al. 2013). The human population in this planning region is estimated to be over 2.4 million people (U.S. Census Bureau 2015). Except for Arlington County, all portions of this planning region are projected to experience significant human population growth by 2030 (Weldon Cooper Center 2012).

Despite the pressures of an urban environment, this planning region provides habitats for a diversity of SGCN. The Northern Virginia well amphipod and Pizzini's amphipod both occur in this planning region and in no other parts of Virginia. Other Action Plan species that occur in Northern Virginia include the American bittern, dotted skipper, bridle shiner, wood turtle, and brook floater. The region also includes a variety of habitat types such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, and tidally influenced streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during the development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

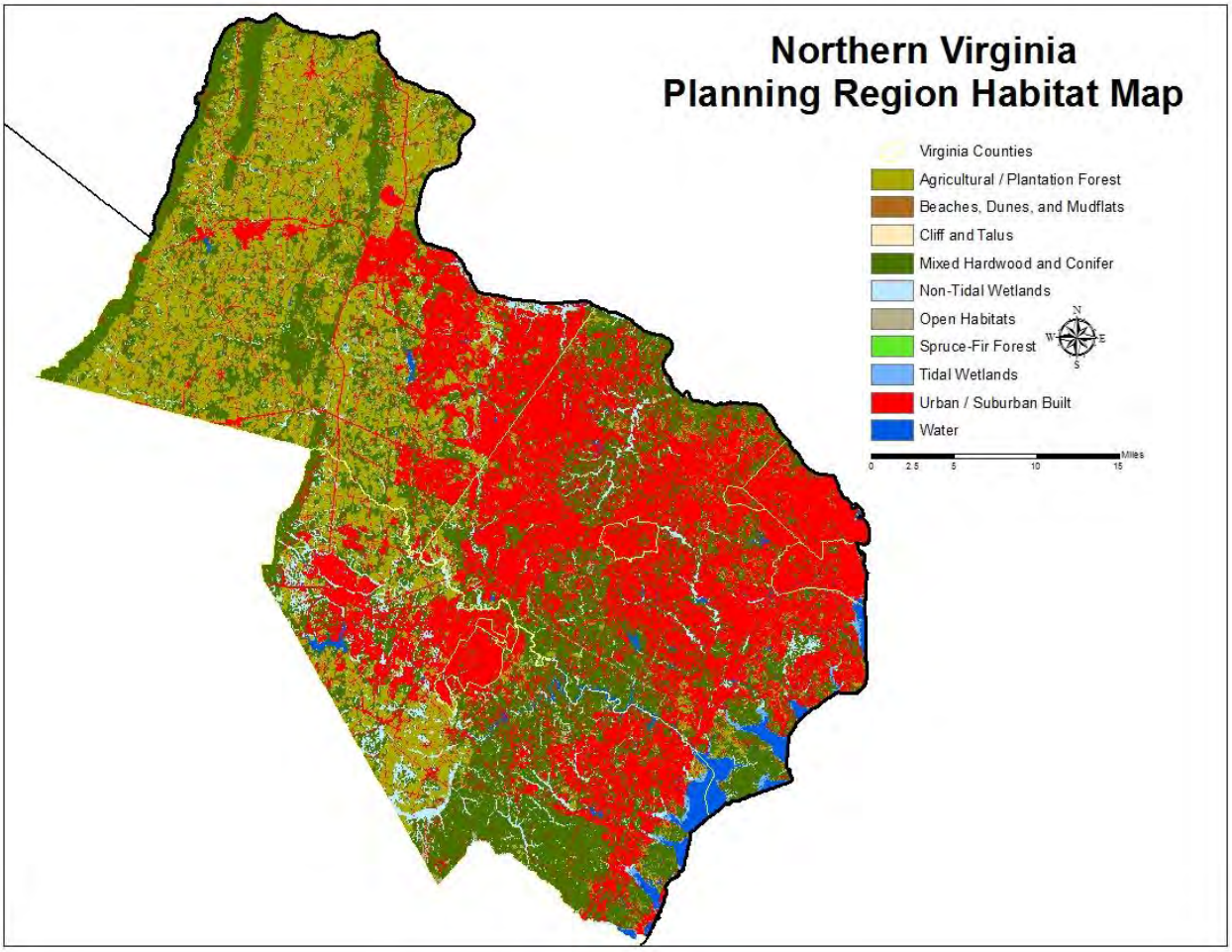

Figure 2. Northern Virginia Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 84 are believed to either occur, or have recently occurred, within the Northern Virginia Planning Region (Appendix A). Of these 84 species, ***39 SGCN are dependent upon habitats provided within the Northern Virginia Planning Region. These species constitute the priority SGCN for the region (Table 2).*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 39 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where

appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Ranking	Number of Priority SGCN
Ia	7
IIb	2
IIc	3
IIIa	5
IIIb	2
IIIc	1
IVa	10
IVb	7
IVc	2

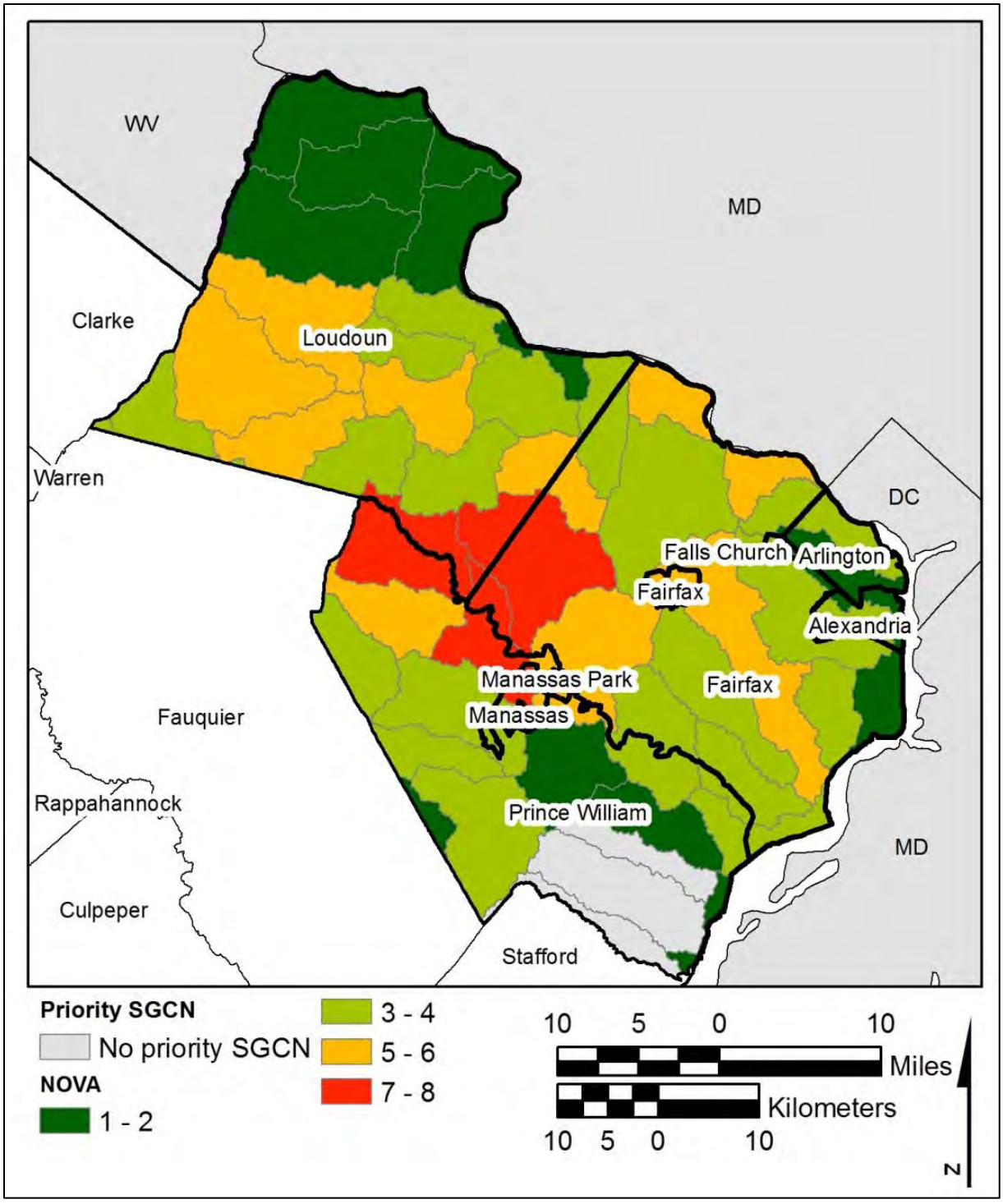

Figure 3. Priority SGCN Density in the Northern Virginia Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution within the Northern Virginia Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		IIi	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows

Bird		I	a	Glossy ibis	*Plegadis falcinellus*	Wooded wetlands, estuarine marshes and waters and saltmarshes
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird		II	b	King rail	*Rallus elegans*	Variety of fresh water and marine marshes and wetlands
Bird		III	b	Least bittern	*Ixobrychus exilis*	Freshwater marshes
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Crustacean	**FS**	I	a	Northern Virginia well amphipod	*Stygobromus phreaticus*	Non-karst species - site specific restricted to seeps and aquifer on Fort Belvoir
Crustacean		II	c	Pizzini's amphipod	*Stygobromus pizzinii*	Non-karst groundwater habitats in Arlington and Fairfax county
Fish		I	a	Bridle shiner	*Notropis bifrenatus*	Slow clear water with aquatic vegetation
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*	Areas with moderate current and sand, rocky, or mud bottom
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*	Clear flowing water with sand or gravel substrates
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*	Clean flowing water with sand and gravel substrates and aquatic vegetation

FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*	Shallow water near stable banks with intact riparian zones and soft substrates
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*	Ponds, canals, and slow moving sections of rivers, often connected to the ocean and can tolerate a wide variety of substrates
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*	Short grass prairies, pine barrens, and woodland meadows
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens/ oak savanna and other open sunny habitats
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*	Clear streams with adjacent riparian forests and fields

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Northern Virginia Planning Region

Recognizing the importance of local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks to wildlife management areas to National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Potomac River NWR,
- Elizabeth Hartwell Mason Neck NWR,
- Occoquan Bay NWR,
- Featherstone NWR,
- Leeslyvania State Park,
- Mason Neck State Park,
- Prince William Forest Park,
- Great Falls National Park,
- Theodore Roosevelt Island National Park,
- Arlington House National Park,
- Bull Run Natural Area Preserve,
- Elklick Woodlands Natural Area Preserve,
- Northern Virginia Park Authority,
- Banshee Reeks Nature Preserve, and

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities. Additionally, multiple military installations, such as Marine Corps Base Quantico, have mission lands that support viable habitats and wildlife populations.

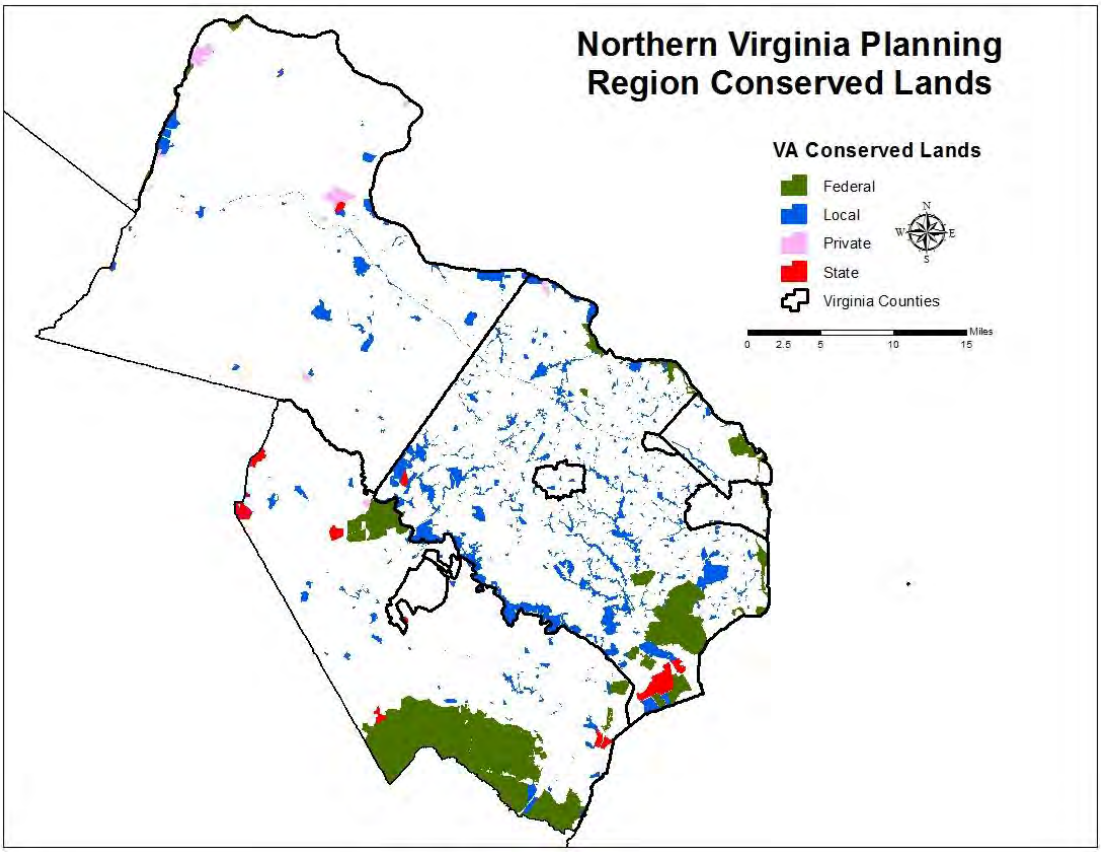

Figure 4. Conservation Lands in the Northern Virginia Planning Region (DCR, Natural Heritage 2014).

These conserved lands serve as an important component of wildlife conservation efforts within Northern Virginia Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Although many of the healthiest and most important habitats have been conserved within their boundaries, working to put additional lands under protection via acquisition, easement, or agreement could benefit many SGCN and habitats within the region.

Climate Change Impacts in Northern Virginia Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SGCN in the Northern Virginia Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example,

if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Because the Northern Virginia Planning Region is located further inland and much of the area along the Potomac is protected, impacts from sea-level rise will likely be less intense than in other coastal regions of the state (VIMS 2013). However, over time, it is possible areas along the Potomac will experience some effects from sea-level rise and storm surge from more intense storm events (VIMS 2013). A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events are expected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are expected to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013).

Conservation Threats and Actions for Wildlife and Habitats in the Northern Virginia Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized below in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Northern Virginia Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Northern Virginia Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., the Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, climate change, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watersheds with priority wetlands and areas adjacent to priority wetlands that allow inland migration of wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Restore stream corridors and riparian areas; 2) Establish riparian buffers; 3) Implement storm water treatment BMPs; 4) Reduce urban storm water runoff; 5) Eliminate illicit connections that allow untreated or partially treated sewage to enter the storm drain system; 6) Correct failing septic systems and "straight pipe" discharges to prevent the discharge of human waste into streams; 7) Maintain sewer systems; 8) Exclude livestock (primarily cattle and horses) from streams; 9) Work to limit opportunities for dog feces to contaminate waterways; 10) Continue to identify impaired waters within the planning region; 11) Monitor and address invasive species impacts; and 12) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, impervious surface, land conversion/ alteration, invasive species, water withdrawals, climate change	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Catoctin Creek and Four Mile Run
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species. 6) Reduce deer numbers	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore of native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Open habitats supporting SGCN

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Northern Virginia Planning Region (Table 4). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes provide valuable habitats for SGCN such as the glossy ibis and a variety of other species.

Table 4. Wetland Acreage in the Northern Virginia Planning Region (Anderson et al. 2013).

Wetland Type	Acreage	Percent of Planning Region
Non-Tidal	37,154.87	4.33%
Tidal	2,680.13	0.31%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to tidal and non-tidal wetlands is conversion to other uses and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of wetland habitat through damage or loss to wetland vegetation. Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: *Phragmites*, purple loosestrife, and exotic invertebrates.

4. Climate Change: As sea levels rise, marshes can be inundated and convert to shallow open water habitats or non-tidal and brackish wetlands may convert to higher salinity marshes. Shallow open water habitats and salt marshes will not support the same vegetative composition as the existing non-tidal and tidal wetlands in this planning region, affecting the wildlife species that depend on these habitats (CCSP 2009). Additionally, as storms become more intense, more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances (CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Northern Virginia Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia have established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option to for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation to protect wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate as conditions change (Kane 2011) (VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Although a proportion of wetlands in the planning region are under conservation, the protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Northern Virginia Planning Region include those wetlands that are inland of tidal wetlands that may provide some opportunity for inland migration as sea levels rise. These more inland areas also allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of the wetland conservation priority areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). Multiple priority

areas for conservation and restoration are adjacent to already conserved lands, especially in the eastern part of the planning region. Multiple wetland conservation and restoration opportunities also exist in Loudoun County.

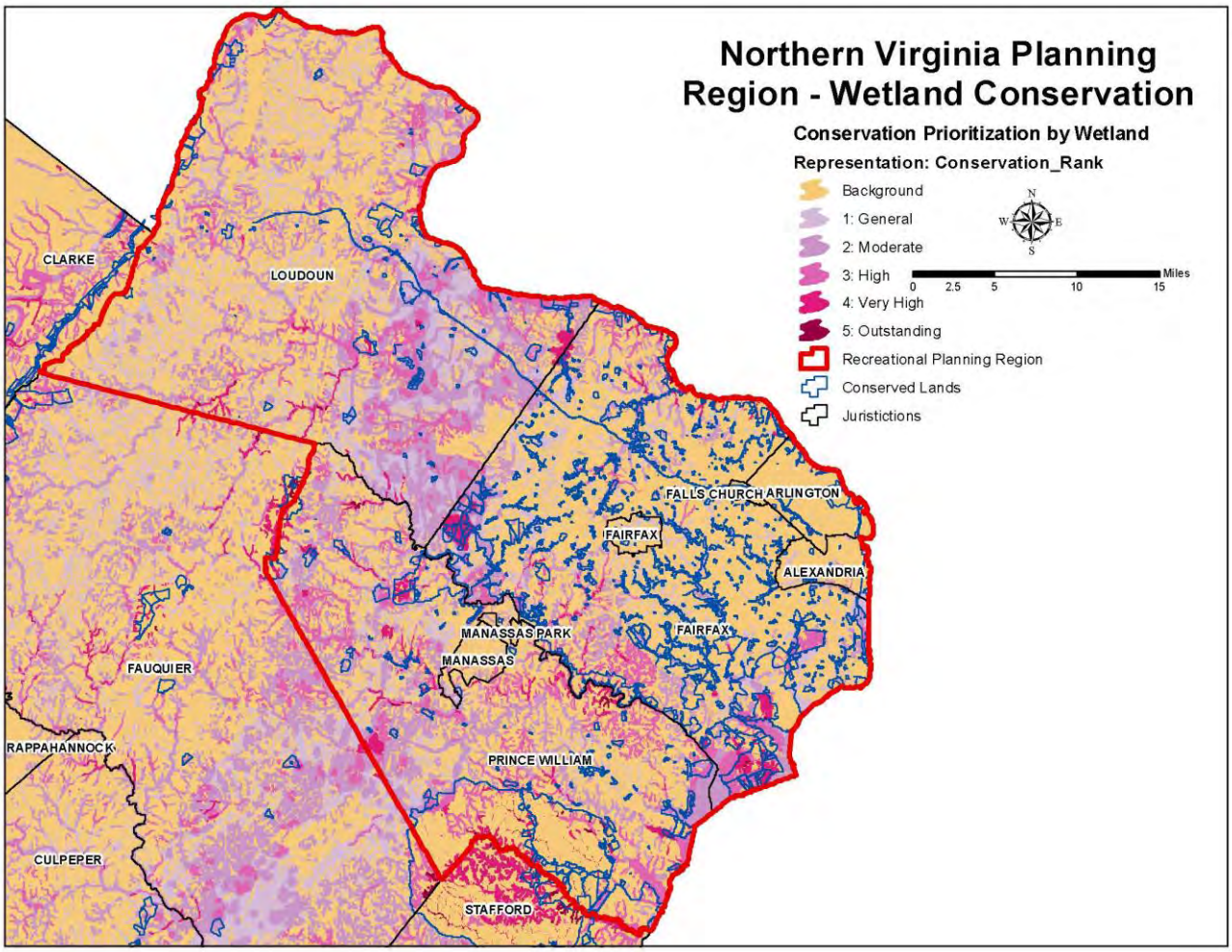

Figure 5. Wetlands Conservation Priorities in the Northern Virginia Planning Region (Weber and Bulluck 2014).

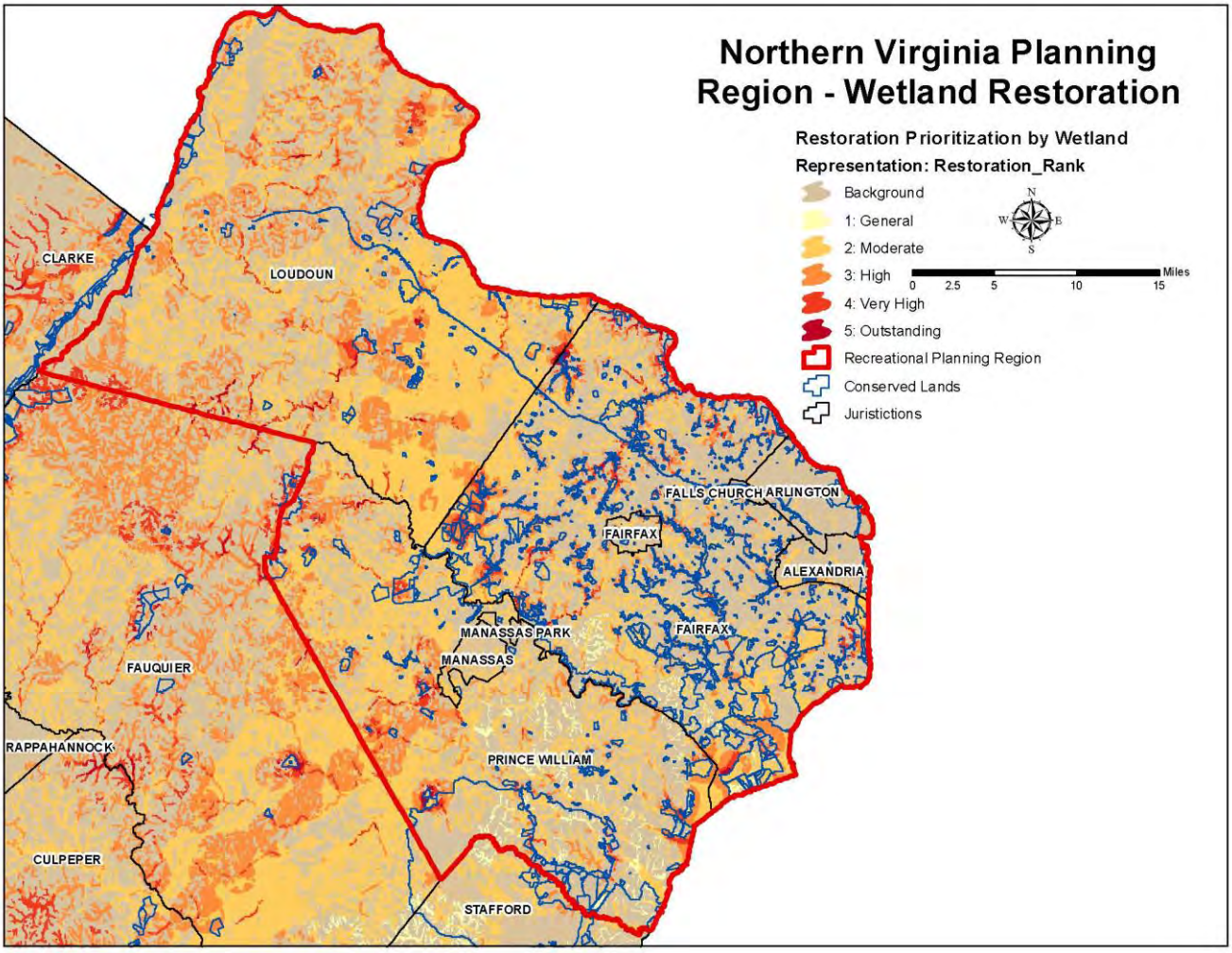

Figure 6. Wetland Restoration Priorities in the Northern Virginia Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

The Northern Virginia Planning Region lies within the Potomac River watershed. Portions of the Potomac River and its tributaries are tidally influenced while other portions of the watershed are not. Approximately 18,400 acres (2.1 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include Northern Virginia well amphipod, Pizzini's amphipod, bridle shiner, brook floater, Atlantic spike, and Northern lance, among others.

Threats

Aquatic and riparian habitats within the Northern Virginia Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species (including ground water species) and riparian habitats within the Northern Virginia Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. A significant portion of the Northern Virginia Planning Region has a high percentage of impervious surface cover (Figure 7).

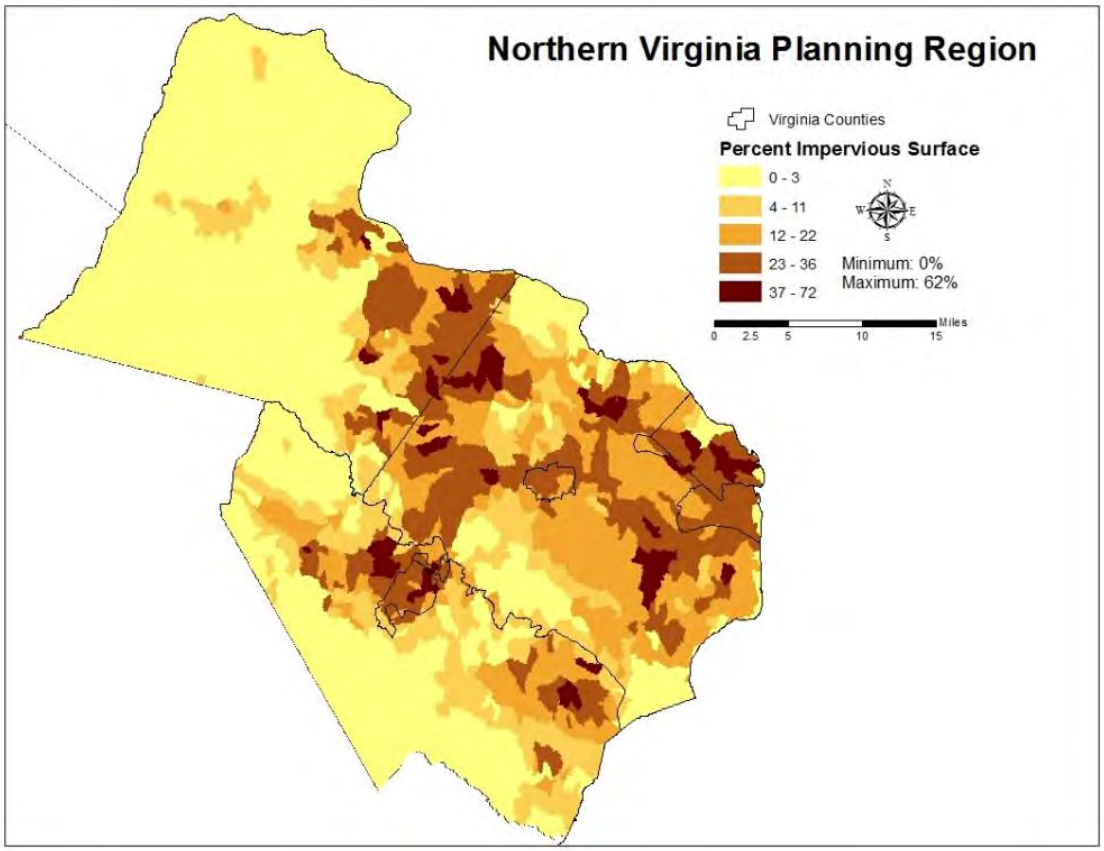

Figure 7. Impervious Surface Cover in North Virginia Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Northern Virginia Planning Region include invasive species such as *hydrilla*, zebra mussel, and northern snakehead fish. *Hydrilla* forms dense mats that crowds out native aquatic vegetation, shades other vegetation, and can block waterways. Zebra mussels were found in a quarry in Northern Virginia and quickly eradicated by DGIF and partners; however, the threat remains (VISWG 2015). These mussels form dense colonies that can clog and block water intake pipes (VISWG 2012). The snakehead is found in the Potomac River and various tributaries in the watershed. It can out-compete native freshwater fish and potentially introduce new pathogens (VISWG 2012).

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the aquifer that could degrade the quality of both subterranean and surface water.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Sea-level rise could result in inundation of shoreline, while changes in air temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Water Quality Improvement Plans for Catoctin Creek (MapTech 2004) and Four Mile Run (NRVC 2004) (Figure 8).

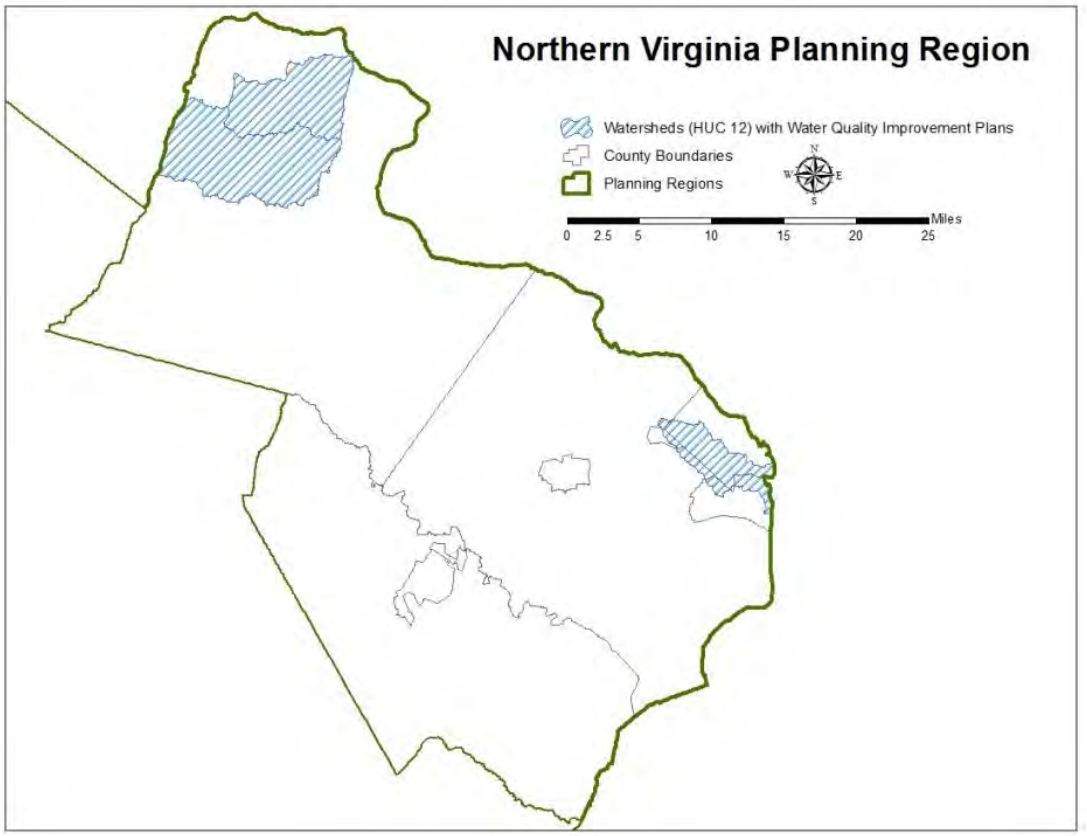

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Restoring stream corridors and riparian areas;
- Establishing riparian buffers;
- Implementing storm water treatment BMPs - maintaining street sweeping, cleaning catchment basins, and maintaining storm drains;
- Reducing storm water runoff;
- Eliminating illicit connections that allow untreated or partially treated sewage to enter the storm drain system;
- Maintaining sewer systems;
- Excluding livestock (primarily cattle and horses) from streams; and
- Working to limit opportunities for dog feces to contaminate waterways.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region. These watersheds are prioritized for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

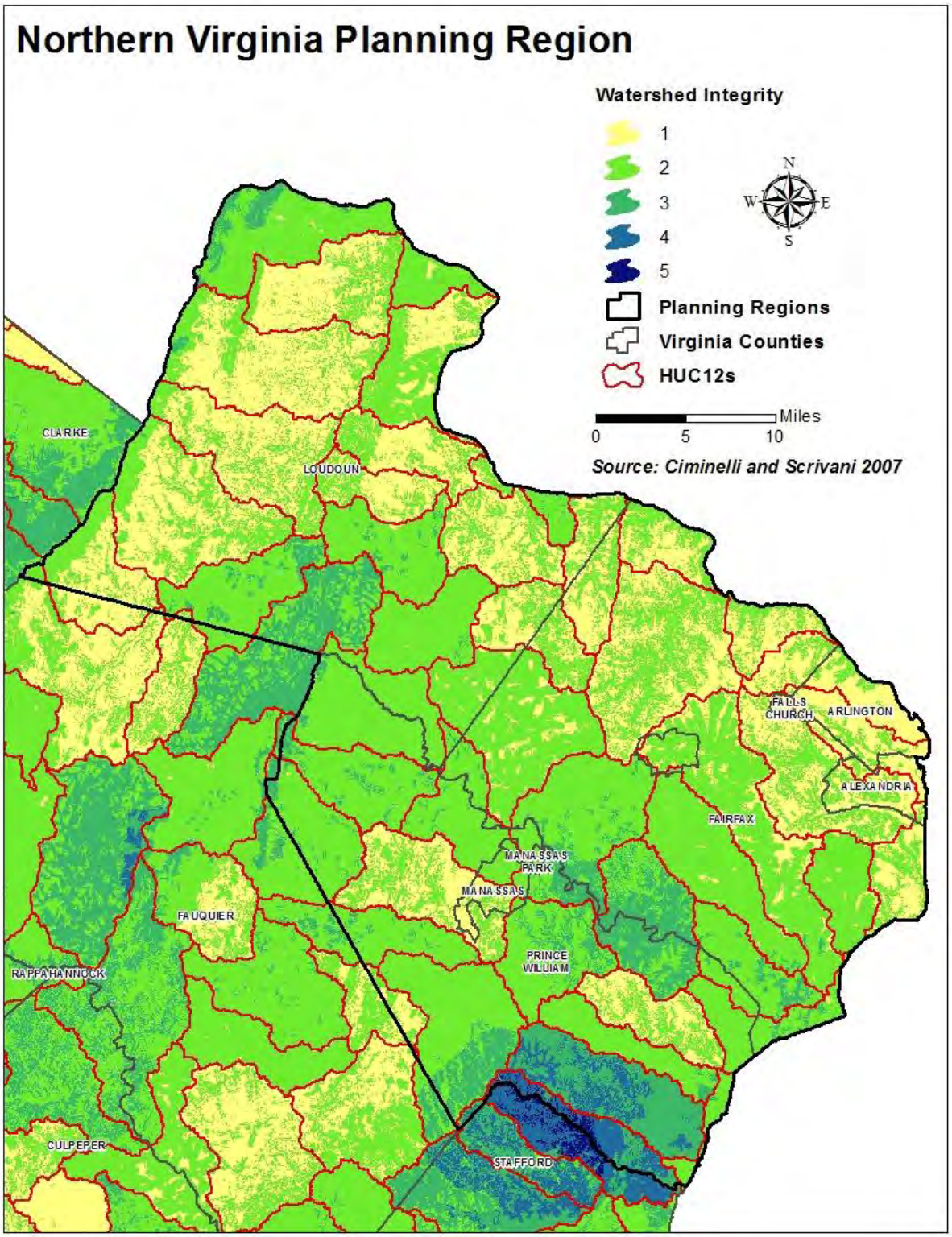

Figure 9. Watershed Integrity Model for Northern Virginia Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Northern Virginia Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses which, if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

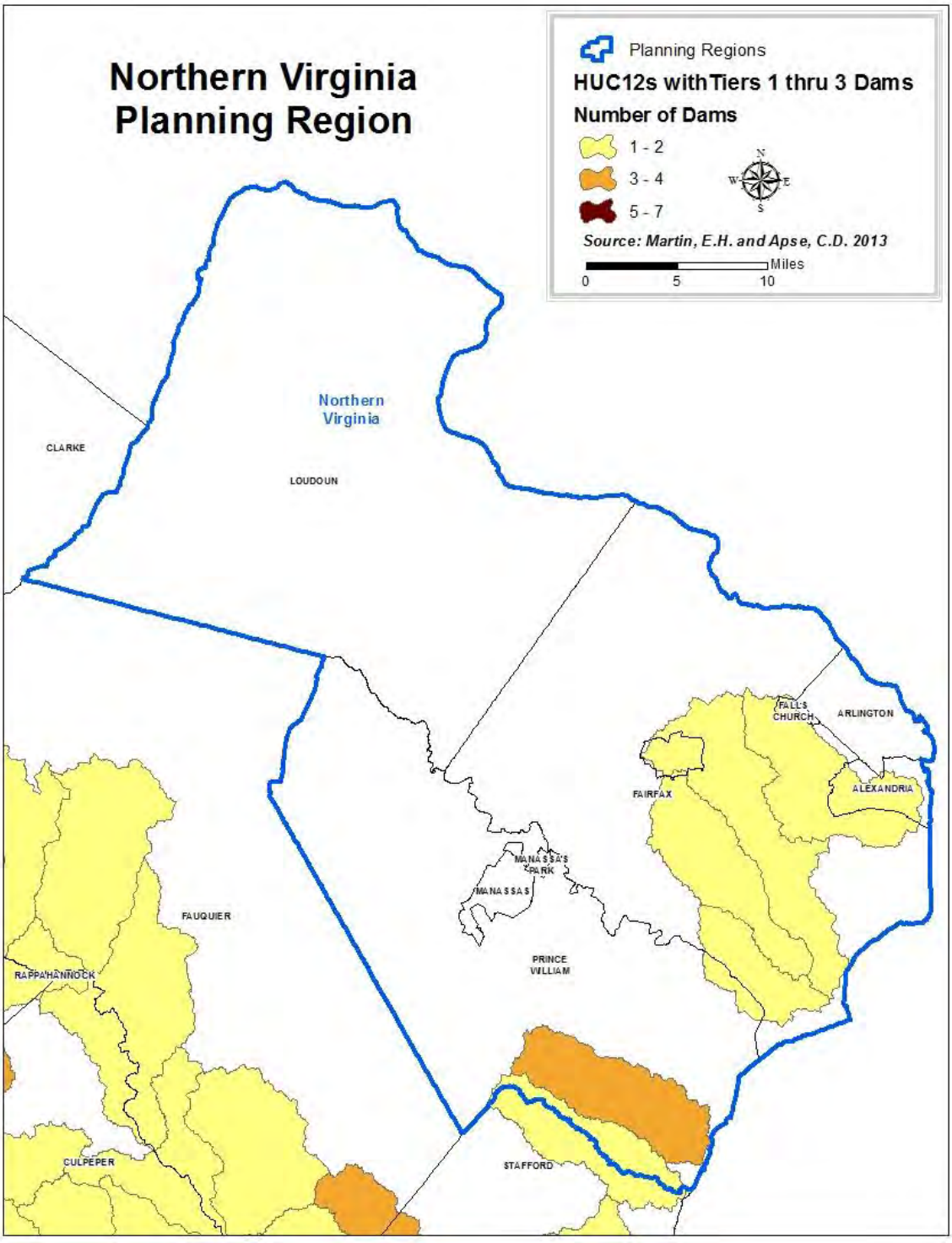

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Northern Virginia Planning Region include monitoring and addressing invasive species impacts, and working with the planning region local

governments to adopt land use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks could also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers could consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species also should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Because sea-level rise will likely be an issue, vegetation species that also have a broader salinity tolerance should be considered. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up approximately one third of Northern Virginia Planning Region and are important for a broad range of species (Table 5). Within this forest type the majority of the trees are mature. Young forest habitat, loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitats for a variety of priority SGCN species, including the wood turtle, Eastern whip-poor-will, and Kentucky warbler, among other bird species.

Table 5. Forest Acreage Totals in Northern Virginia Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	285,888.13	33.33%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Northern Virginia Planning Region is fragmentation, which is mainly due to expanding development within the region and resulting roads and infrastructure. In many cases with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

4. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates deer populations in the Northern Virginia Planning Region need to be reduced in order to meet a variety of social and ecological goals (DGIF 2015). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. Deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive plants are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in the Northern Virginia Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges; if feasible, using a mix of tree species to help minimize susceptibility to pests; preventing unnecessary site disturbance; and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent their spread. Some of these forest habitats may need to be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times within Virginia's current Deer Management Plan and will be similarly addressed in the revised 2015-2024 Deer Management Plan (DGIF 2015). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Northern Virginia Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SGCN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 11,310 acres (1.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than two percent), these habitats are important for priority SGCN, including the Eastern meadowlark, grasshopper sparrow, yellow breasted chat, dotted skipper and Persius duskywing butterfly, among other species.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land uses within this planning region. Between 1970 and 2010, this planning region's human population increased by over 1.2 million people, and from 1969 to 2012 the number of farm acres declined by over 56 percent (USDA 2012). As human population grew, significant areas were developed for commercial and residential uses that are less conducive for open habitat species. In other cases, retired agricultural lands have been allowed to remain fallow. As these post-agricultural habitats have aged, they have lost their open character as trees have aged and areas have become forest (USDA 1974).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

3. Lack of Fire: Savannas are a fire-dependent habitat, and the few existing savannas in this planning region occur on military facilities where mission activities maintain the open character. While existing savannas appear secure, the region's large human population and associated development will limit opportunities for controlled burns needed to establish new savanna patches.

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees

(DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). The Natural Resources Conservation Service (NRCS) provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

A few patches of glade habitats occur within this planning region. The majority occur on private lands. The key to their conservation will involve working with willing private landowners to conserve and restore those habitats through acquisition, easement, or agreement.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse composition of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-native species and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of open habitats will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/After comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect.

However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in this planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within Northern Virginia Planning Region, priority conservation opportunities include:

- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Improving the quality and quantity of water in creeks and rivers through best management practices and water quality improvement mechanisms.
- Conserving tracts of mature hardwood and conifer forests.
- Maintaining existing open habitats and pursuing opportunities to restore native open habitats and young forests.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN NORTHERN VIRGINIA PLANNING REGION

Complete SGCN list for the Northern Virginia Planning Region (SGCN=84). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup (winter)	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird	**ST**	I	a	Henslow's sparrow	*Ammodramus henslowii*

Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		II	b	King rail	*Rallus elegans*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	I	a	Northern Virginia well amphipod	*Stygobromus phreaticus*
Crustacean		II	c	Pizzini's amphipod	*Stygobromus pizzinii*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Logperch	*Percina caprodes*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*

FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

19. Rappahannock-Rapidan Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through WCRP and SWG, that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B, and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

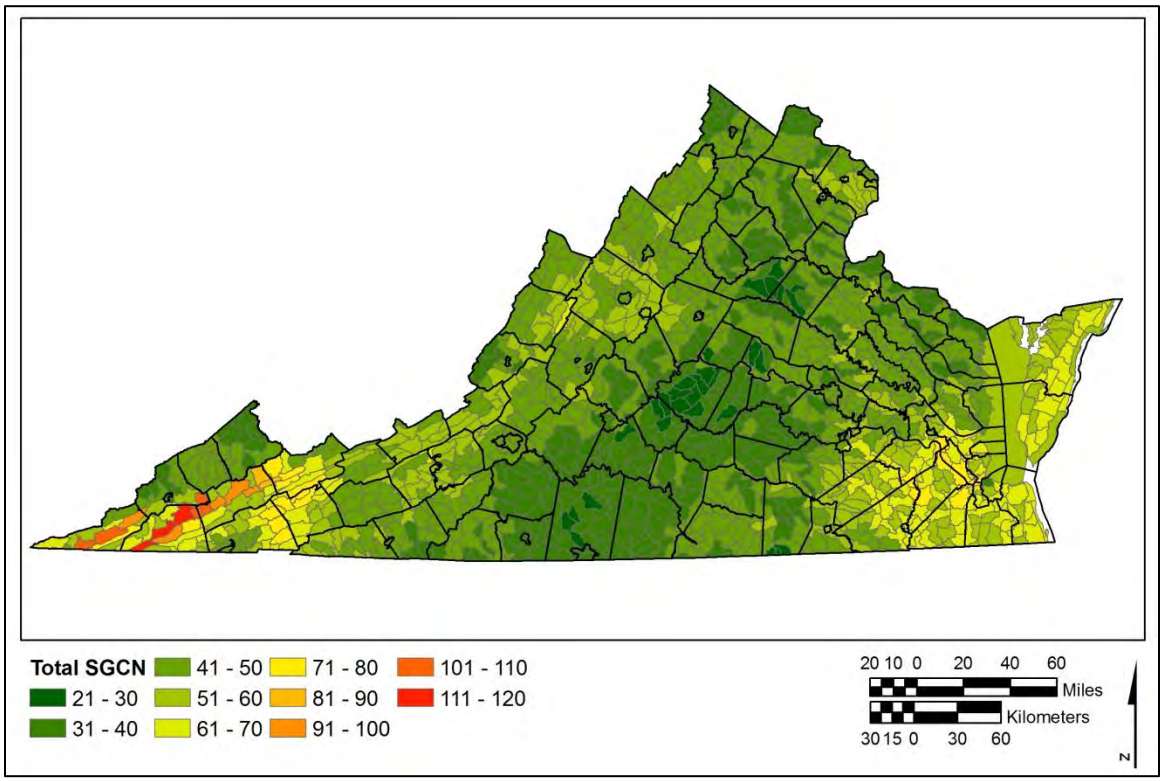

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

RAPPAHANNOCK-RAPIDAN REGIONAL COMMISSION SUMMARY OVERVIEW

The Rappahannock-Rapidan Planning Region consists of 1,259,414 acres (1,968 square miles) and includes Culpeper, Fauquier, Madison, Orange, and Rappahannock counties and the towns of Culpeper, Gordonsville, Madison, Orange, Remington, Warrenton, and Washington. The human population in this planning region is estimated at almost 173,000 people (U.S. Census Bureau 2015). All counties are projected to experience increases in population by 2020, 2030, and 2040, with Fauquier and Culpepper experiencing the greatest growth (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. This planning region provides aquatic habitats for a range of SGCN such as the panhandle pebblesnail that has 100 percent of its distribution within the region, Carolina lance, and least brook lamprey. Its forests are home to the Shenandoah salamander as well as the variable mantle slug and ribbed striate snail. The region also includes a variety of other habitats, such as mature mixed hardwood and conifer forests, young forests, retired agricultural land, non-tidal wetlands, and freshwater streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

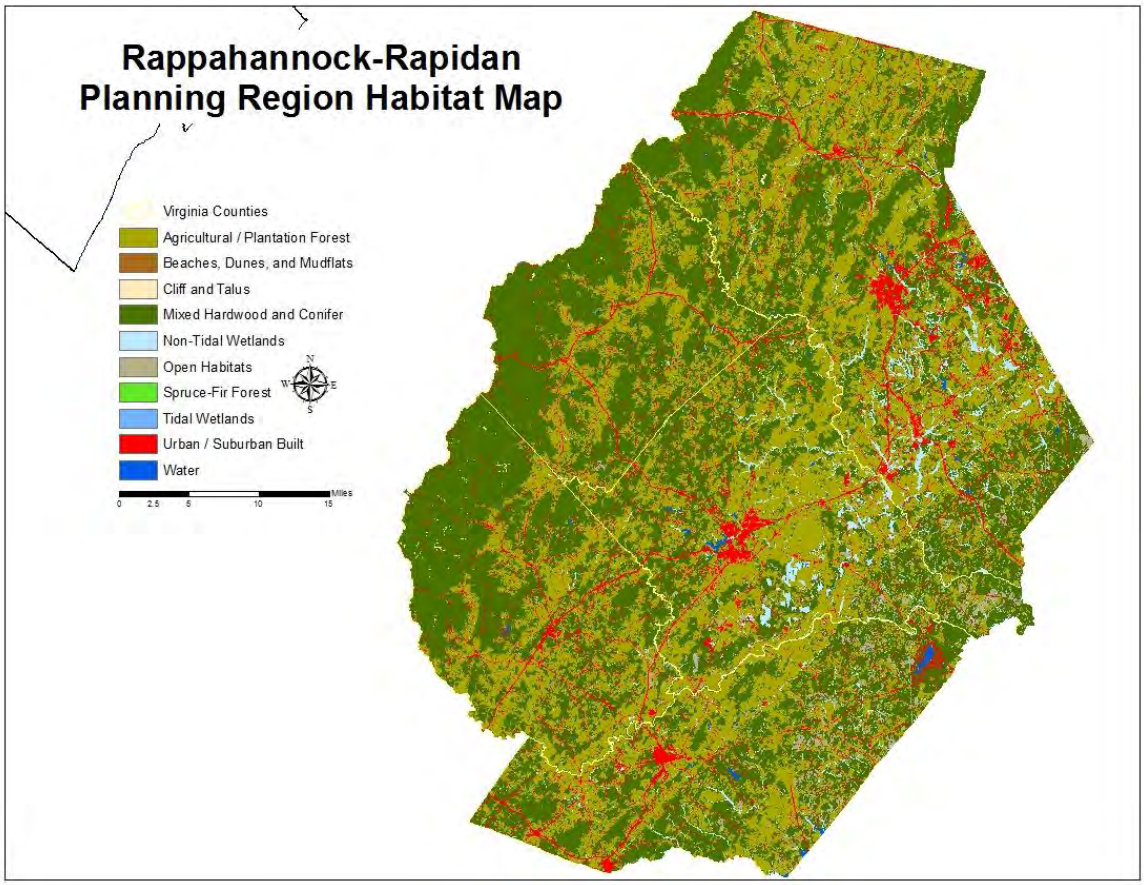

Figure 2. Rappahannock-Rapidan Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 93 are believed to either occur, or have recently occurred, within the Rappahannock-Rapidan Planning Region (Appendix A). Of these 93 species, ***47 SGCN are dependent upon habitats provided within the Rappahannock- Rapidan Planning Region (Table 2***Figure ***). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 46 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	3
Ic	2
IIa	2
IIb	2
IIc	3
IIIa	6
IIIb	1
IIIc	3
IVa	12
IVb	8
IVc	5

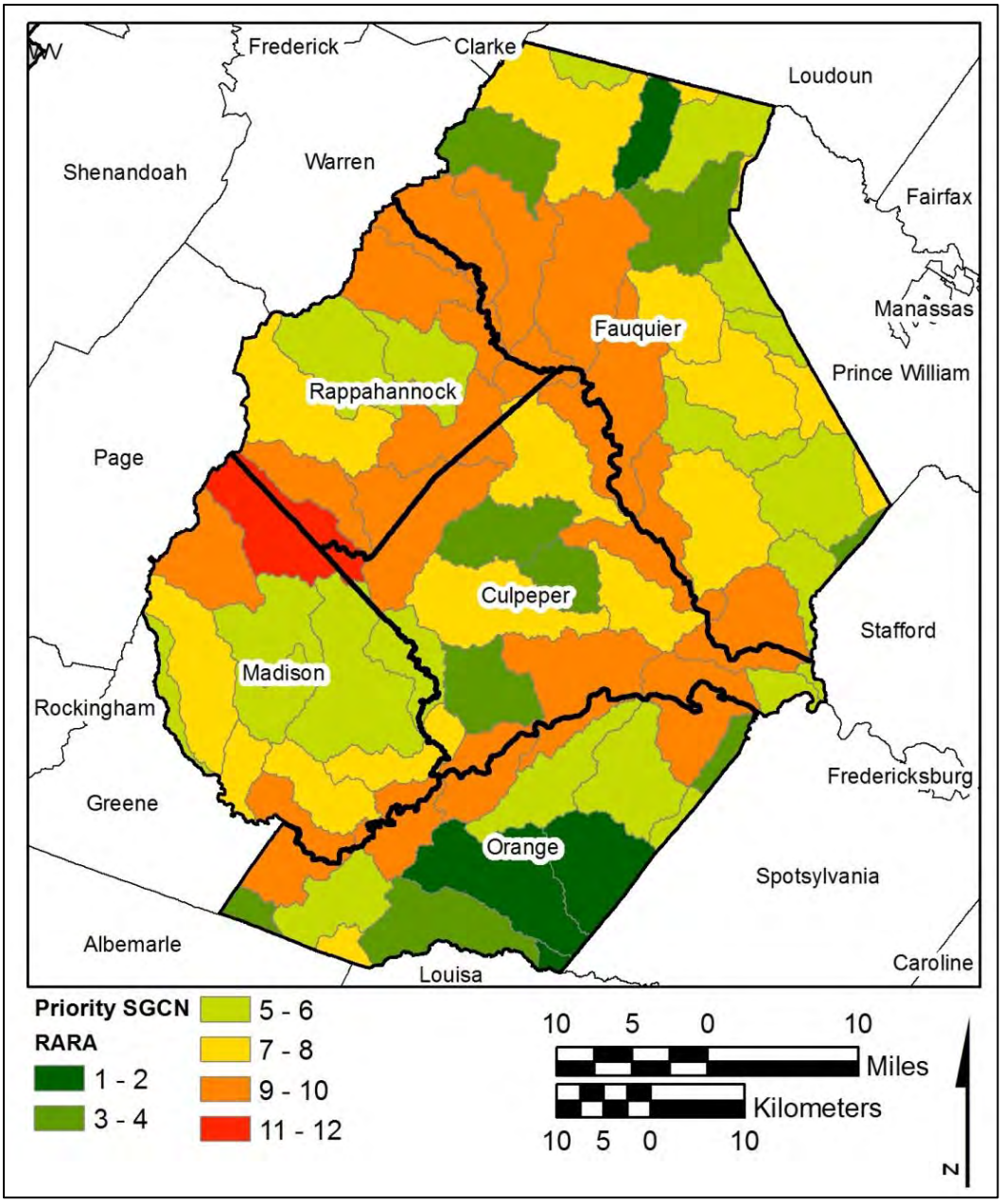

Figure 3. Priority SGCN Density in the Rappahannock-Rapidan Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Rappahannock-Rapidan Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*	West of Shenandoah River - high elevation hardwood forests
Amphibian	**FESE**	I	c	Shenandoah salamander	*Plethodon shenandoah*	Handful of sites in Shenandoah National Park
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.

Bird		III	a	Eastern whip-poor-will	*Caprimulgus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoon
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards, and open areas with scattered trees
Bird		III	a	Northern Bobwhite	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west

Crustacean	**FS**	II	b	Luray Caverns amphipod	*Stygobromus pseudospinosus*	Caves with clean abundant water flowing through the system
Fish		IV	c	American brook lamprey	*Lampetra appendix*	Requires clear flowing water but can tolerate a range of temperatures and substrates
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*	Warm small streams with slow flows and sand/ silt substrates
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*	Areas with moderate current and sand, rocky, or mud bottom
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*	Springs and cave streams in the Potomac basin and along the Blue Ridge
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*	Clean flowing water with sand and gravel substrates and aquatic vegetation
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*	Clean warm streams and rivers with low to moderate current and unsilted substrates
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*	Shallow water near stable banks with intact riparian zones and soft substrates
FW Mollusk	**FS**	II	c	Panhandle pebblesnail	*Somatogyrus virginicus*	Very clear flowing water with rocky substrates
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*	Clean streams with stable banks and sand or gravel substrates
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*	Requires slow currents with unsilted sandy substrates and can tolerate a various water sizes
Insect	**FS**	II	c	Hubbard's cave beetle	*Pseudanophthalmus hubbardi*	Caves with clean abundant water flowing through the system
Insect	**FS**	II	c	Petrunkevitch's cave beetle	*Pseudanophthalmus petrunkevitchi*	Caves with clean abundant water flowing through the system
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*	Glades and prairie remnants
Other Terrestrial Invertebrate		III	c	Depressed glyph	*Glyphyalinia virginica*	No habitats have been identified for this terrestrial snail
Other Terrestrial Invertebrate		IV	c	Ribbed striate	*Striatura exigua*	No habitats have been identified for this terrestrial snail
Other Terrestrial Invertebrate		III	c	Variable mantleslug	*Pallifera varia*	Moist forest habitats

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Rappahannock- Rapidan Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national parks and state parks and forests to state wildlife management areas to conservation easements. Significant conservation assets, in terms of size, include:

- Shenandoah National Park,
- Rapidan Wildlife Management Area,
- G.R. Thompson Wildlife Management Area,
- C.F. Phelps Wildlife Management Area,
- Weston Wildlife Management Area,
- Sky Meadows State Park,
- Spotsylvania National Military Park, and
- Bull Run Mountains State Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 5). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

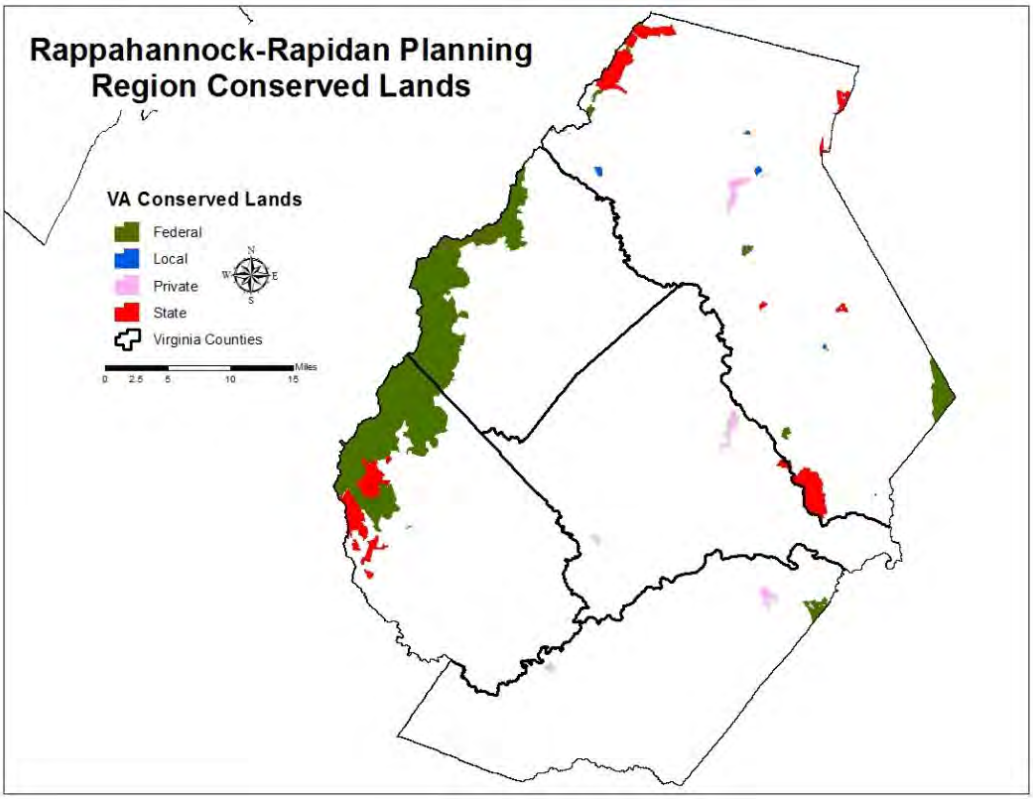

Figure 4. Conservation Lands in the Rappahannock-Rapidan Planning Region (DCR, Natural Heritage 2014).

These conserved lands serve as an important component of wildlife conservation efforts within the Rappahannock-Rapidan Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within this planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Rappahannock-Rapidan Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SGCN in the Rappahannock-Rapidan Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used by Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

CONSERVATION THREATS AND ACTIONS TO WILDLIFE AND HABITATS IN THE RAPPAHANNOCK-RAPIDAN PLANNING REGION.

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Rappahannock-Rapidan Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Rappahannock-Rapidan Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated or forested riparian buffers and incorporate riparian buffers into land use planning and management;2) Reforest erodible pasture or croplands and establish permanent vegetative cover on croplands; 3) Work with private landowners to implement pasture management BMPs; 4) Utilize conservation tillage and cover crop techniques; 5) Establish rain gardens in appropriate sites; 6) Fence livestock and horses out of streams and providing alternative water sources; 7) Improve pasture and loafing lot management to prevent manure-tainted water from flowing into streams; 8) Develop improved methods for incorporating manure and other biosolids into soil; 9) Repair failing septic systems and eliminating "straight pipes;" 10) Work to slow storm water runoff by establishing vegetated buffers, bioretention filters, and infiltration trenches in urban and residential areas; 11) Work to prevent pet waste from entering the watershed; 12) Continue to identify impaired waters within the planning region; 13) Restore connectivity; 14) Monitor and address invasive species impacts; and 15) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities, contribute to clean water supply	Beaver Creek, Mountain Run, Pamunkey Creek, Terrys Creek, Browns Run, Craig Run, Marsh Run, Carter Run, Deep Run, Great Run, Thumb Run, Hazel River, Hughes River, Rush River, Little Dark Run, Robinson River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Rappahannock-Rapidan Planning Region include primarily warm water, non-tidal rivers, streams, and creeks with coldwater stream reaches in Rappahannock and Madison Counties. Watersheds include the Rappahannock and York. Approximately 6,480 acres (0.5 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include the panhandle pebblesnail, Atlantic spike, Carolina lance, Northern lance mussel, brook trout, and American brook lamprey, among others.

Threats

Aquatic and riparian habitats within the Rappahannock-Rapidan Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Rappahannock-Rapidan Planning Region. Fertilizers, eroded sediment, and human and animal waste flow into the region's tidal creeks from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop the flow of these materials and prevent them from running into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Most of the Rappahannock-Rapidan Region has a low percentage of impervious surface cover (Figure 5).

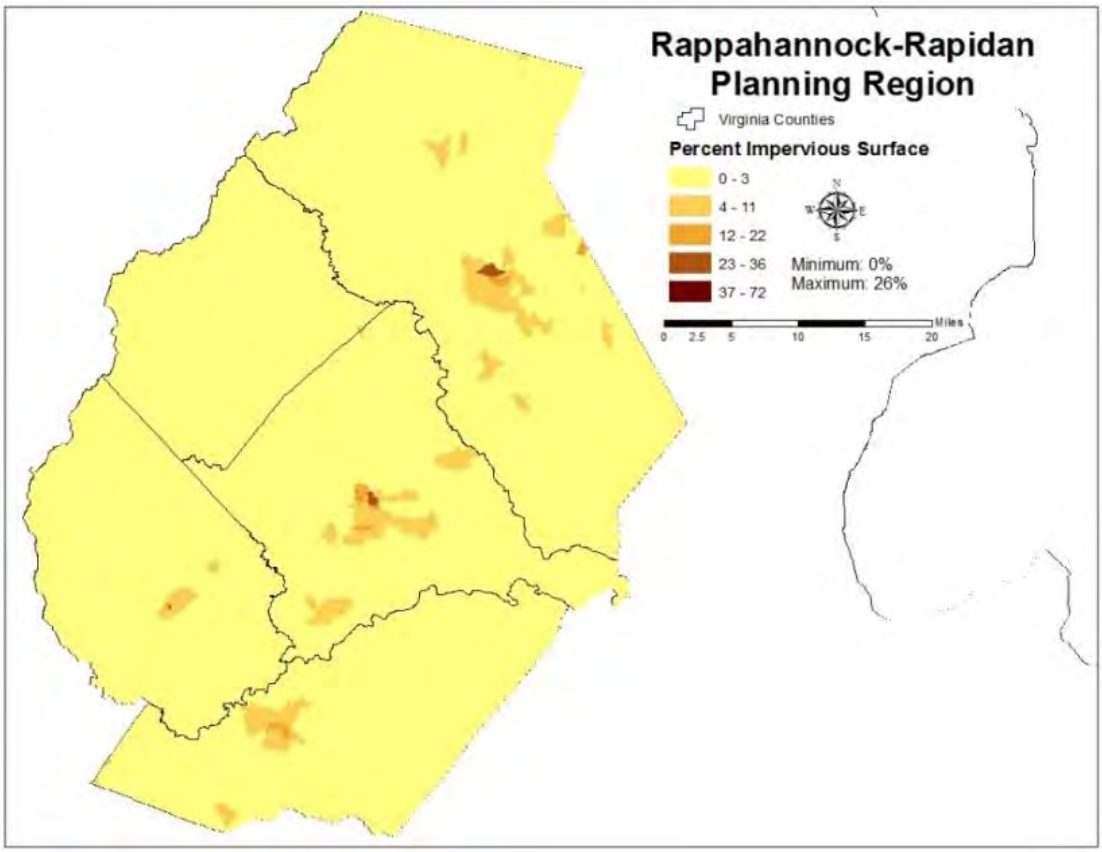

Figure 5. Impervious Surface Cover in Rappahannock-Rapidan Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within t Planning Region include invasive species that either consume native species or consume aquatic vegetation, thereby altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone

summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Beaver Creek, Mountain Run, Pamunkey Creek, and Terrys Creek (Blue Ridge Environmental Solutions 2011a); Browns Run, Craig Run, and Marsh Run (Blue Ridge Environmental Solutions 2009); Carter Run, Deep Run, Great Run, and Thumb Run (Engineering Concepts 2006); Hazel River, Hughes River, and Rush River (Engineering Concepts 2009); and Little Dark Run and Robinson River (Blue Ridge Environmental Solutions 2011b) (Figure 6).

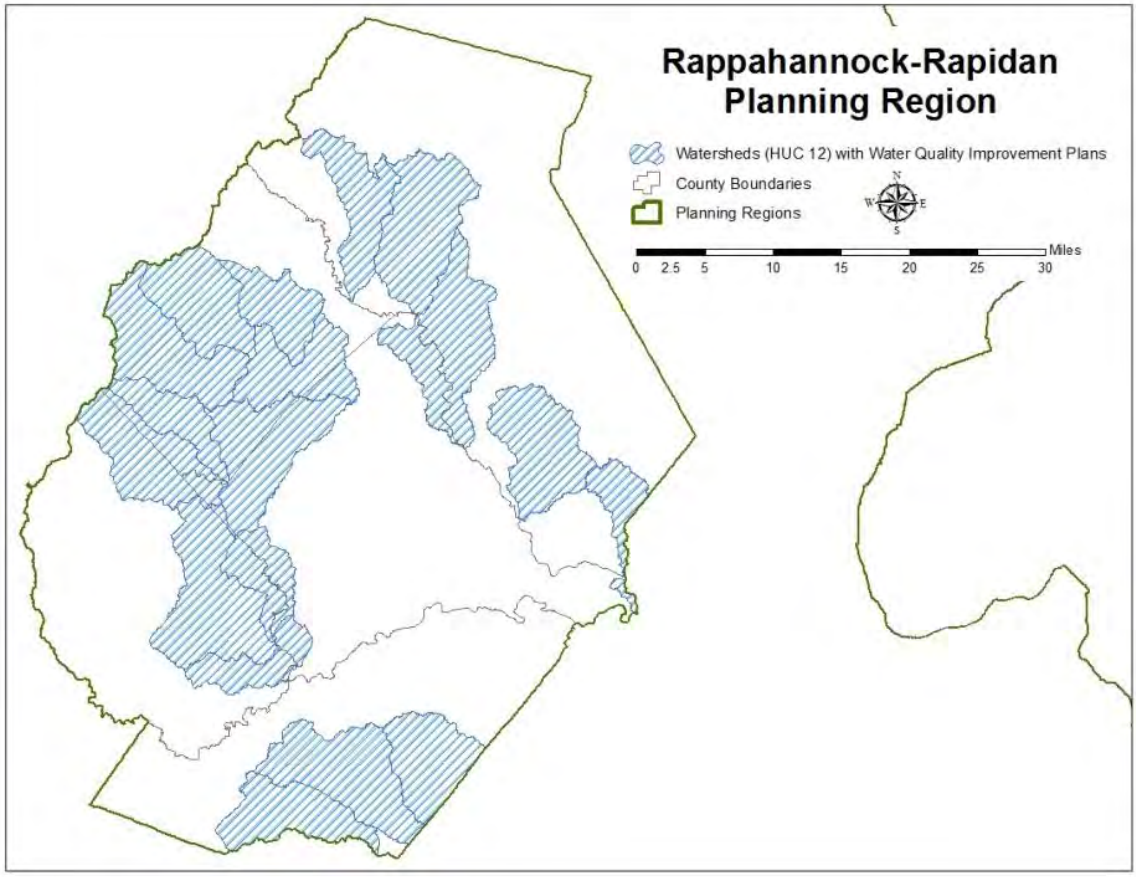

Figure 6. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated or forested riparian buffers and incorporating riparian buffers into land use planning and management;
- Reforesting erodible pasture or croplands and establish permanent vegetative cover on croplands;

- Working with private landowners to implement pasture management BMPs;
- Utilizing conservation tillage and cover crop techniques;
- Establishing rain gardens in appropriate sites;
- Fencing livestock and horses out of streams and providing alternative water sources;
- Improving pasture and loafing lot management to prevent manure-tainted water from flowing into streams;
- Developing improved methods for incorporating manure and other biosolids into soil;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams;
- Working to slow storm water runoff by establishing vegetated buffers, bioretention filters, and infiltration trenches in urban and residential areas; and
- Working to prevent pet waste from entering the watershed.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 7).

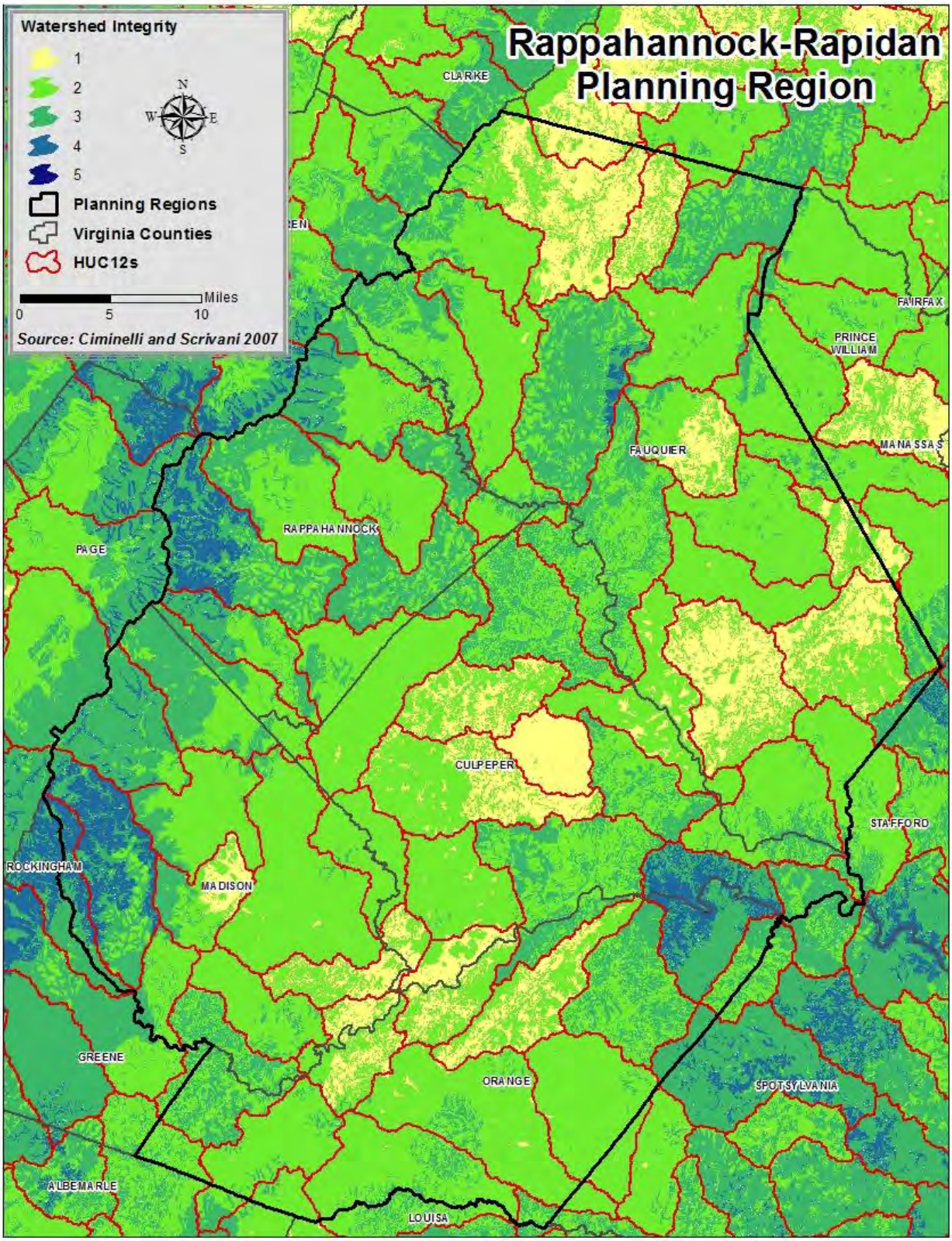

Figure 7. Watershed Integrity Model for Rappahannock-Rapidan Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Rappahannock-Rapidan Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established best management practices (BMPs) for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). The Natural Resources Conservation Service (NRCS) provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 8) (Martin and Apse 2013).

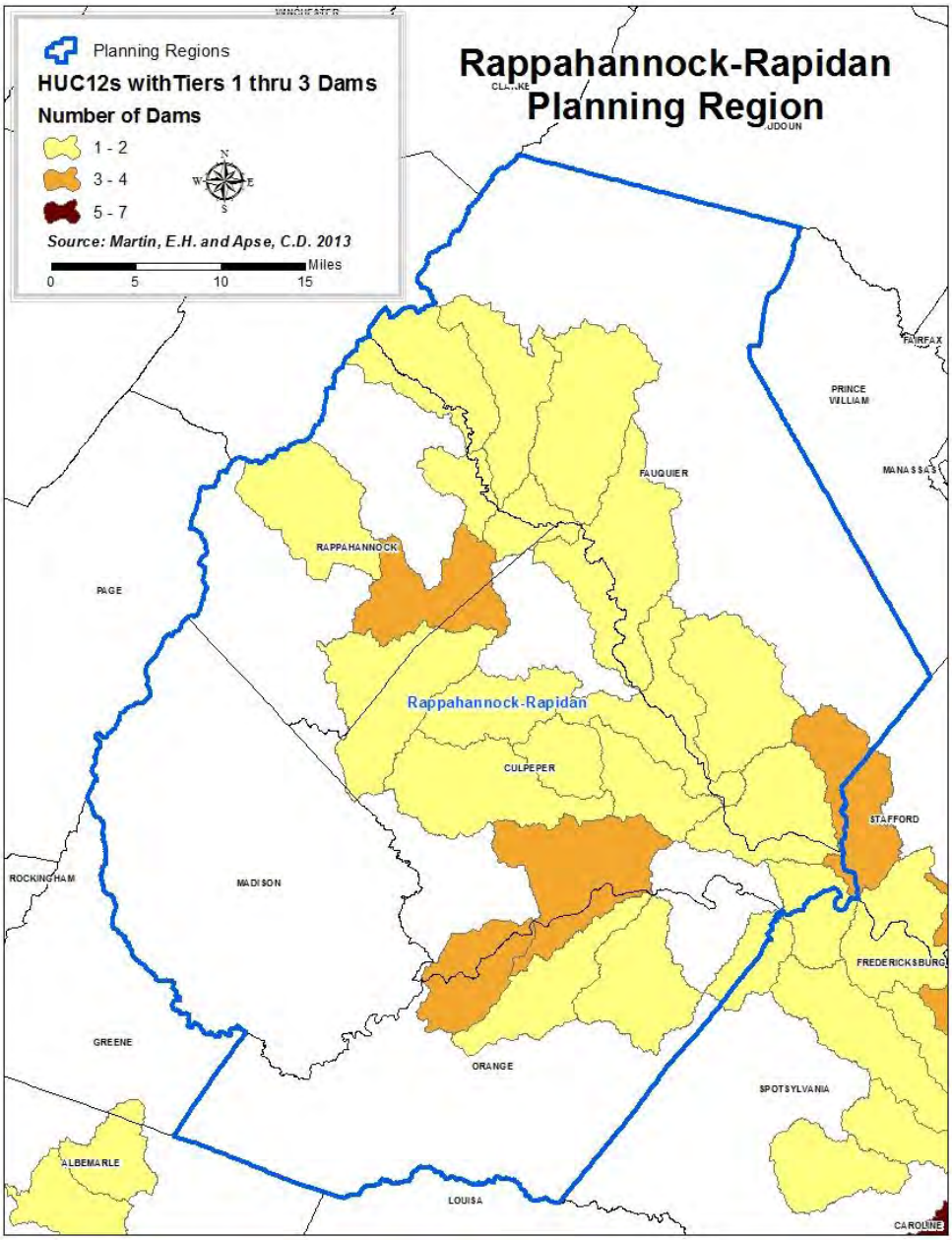

Figure 8. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Rappahannock-Rapidan Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost half of the Rappahannock-Rapidan Planning Region and are important for a broad range of species (Table 4). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests may have been referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the Eastern whip-poor-will, Eastern wood-pewee, ruffed grouse, Shenandoah salamander, variable mantle slug, ribbed striate snail, and the Jefferson salamander, among other species.

Table 4. Forest Acreage Totals in Rappahannock-Rapidan Planning Region (Anderson et al. 2013).

Forest Type	Acres	Percent of Planning Region
Mixed Hardwood and Conifer	608,116.26	48.26%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within the Rappahannock-Rapidan Planning Region is fragmentation, mainly due to expanding development and resulting roads. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to

waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Rappahannock-Rapidan Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Upper York River Basin Watershed Implementation Plan* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Beaver Creek, Mountain Run, Pamunkey Creek, and Terrys Run watersheds to help decrease sediment run off as well as provide wildlife habitat (Blue Ridge Environmental Solutions 2011).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Rappahannock-Rapidan Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SGCN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Managers may wish to

consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for action plan species. Open habitats are often comprised of post-agricultural lands, glades, barrens, outcrop and summit scrub and make up approximately 27,720 acres (2.2 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These open habitats provide habitat for the loggerhead shrike, barn owl, Eastern meadowlark, grasshopper sparrow, and regal fritillary among other species.

Threats

Changing land use patterns has played a large role in the loss of open and young forests habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Culpepper, Orange, Rappahannock, and Madison Counties offer some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management.

A few patches of glade habitats occur within this planning region. The majority occur on private lands. The key to their conservation will involve working with willing private landowners to conserve and restore those habitats through acquisition, easement, or agreement.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

Conclusion

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of

this “common wealth.” The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan’s long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Rappahannock-Rapidan Planning Region, priority conservation opportunities include:

- Protecting the quantity and quality of water.
- Maintain and conserve patches of mixed hardwood conifer forests.
- Maintaining open habitats and pursuing opportunities to restore native grasslands where possible.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN RAPPAHANNOCK-RAPIDAN PLANNING REGION

Complete SGCN list for the Rappahannock-Rapidan Planning Region (SGCN=92). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian	**FESE**	I	c	Shenandoah salamander	*Plethodon shenandoah*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*

Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	II	b	Luray Caverns amphipod	*Stygobromus pseudospinosus*
Crustacean	**FTST**	II	c	Madison Cave isopod	*Antrolana lira*
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Slimy sculpin	*Cottus cognatus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk	**FS**	II	c	Panhandle pebblesnail	*Somatogyrus virginicus*
FW Mollusk		IV	a	Pocketbook mussel	*Lampsilis ovata*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*

FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*
Insect	**FS**	II	c	Hubbard's cave beetle	*Pseudanophthalmus hubbardi*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect	**FS**	II	c	Petrunkevitch's cave beetle	*Pseudanophthalmus petrunkevitchi*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Terrestrial Invertebrates		III	c	Depressed glyph	*Glyphyalinia virginica*
Other Terrestrial Invertebrates		IV	c	Ribbed striate	*Striatura exigua*
Other Terrestrial Invertebrates		III	c	Variable mantleslug	*Pallifera varia*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile	**ST**	I	a	Wood turtle	*Glyptemys insculpta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

20. Region 2000 Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Action Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN in the Plan are listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

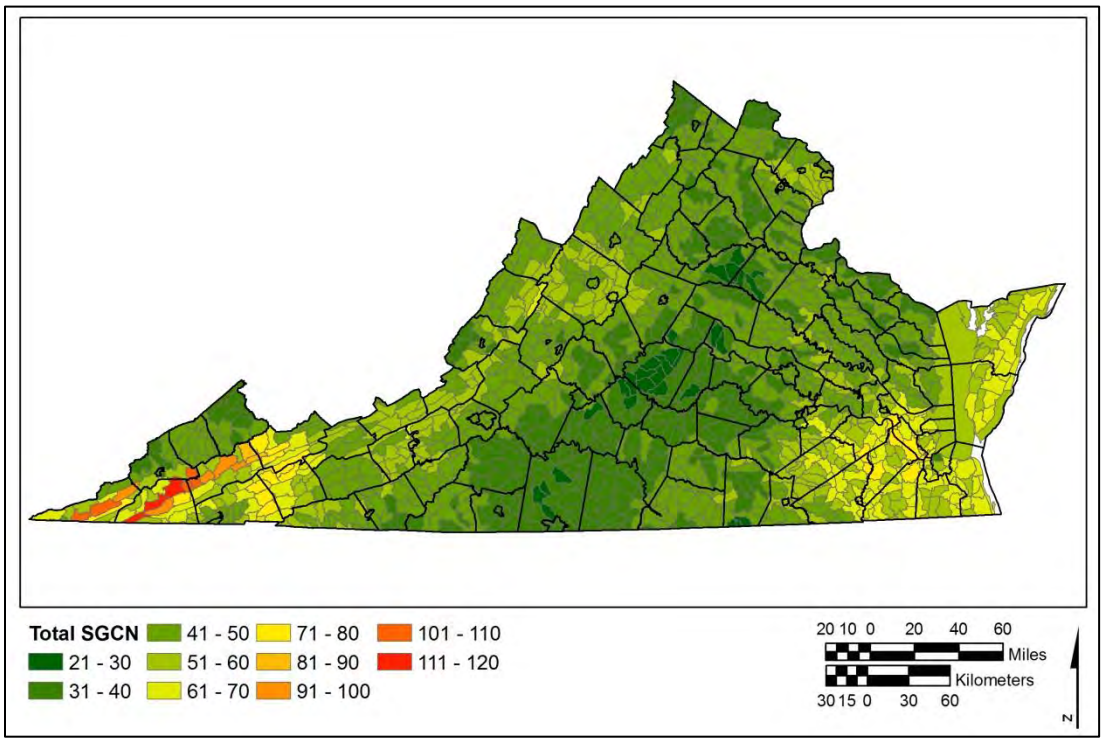

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

REGION 2000 PLANNING REGION SUMMARY OVERVIEW

Region 2000 Planning Region consists of 1,373,697 acres (2,146 square miles) and includes the counties of Amherst, Appomattox, Bedford, and Campbell; cities of Bedford, and Lynchburg; and towns of Altavista, Amherst, Appomattox, and Brookneal. The human population in this planning region is estimated to be almost 258,000 people (U.S. Census Bureau 2015). The planning region is projected to experience some population growth by 2030 (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including the two species that occur only within this region and nowhere else in the world. They include the Gammon's Stenelmis riffle beetle and the Appalachian snaketail. The planning region also includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

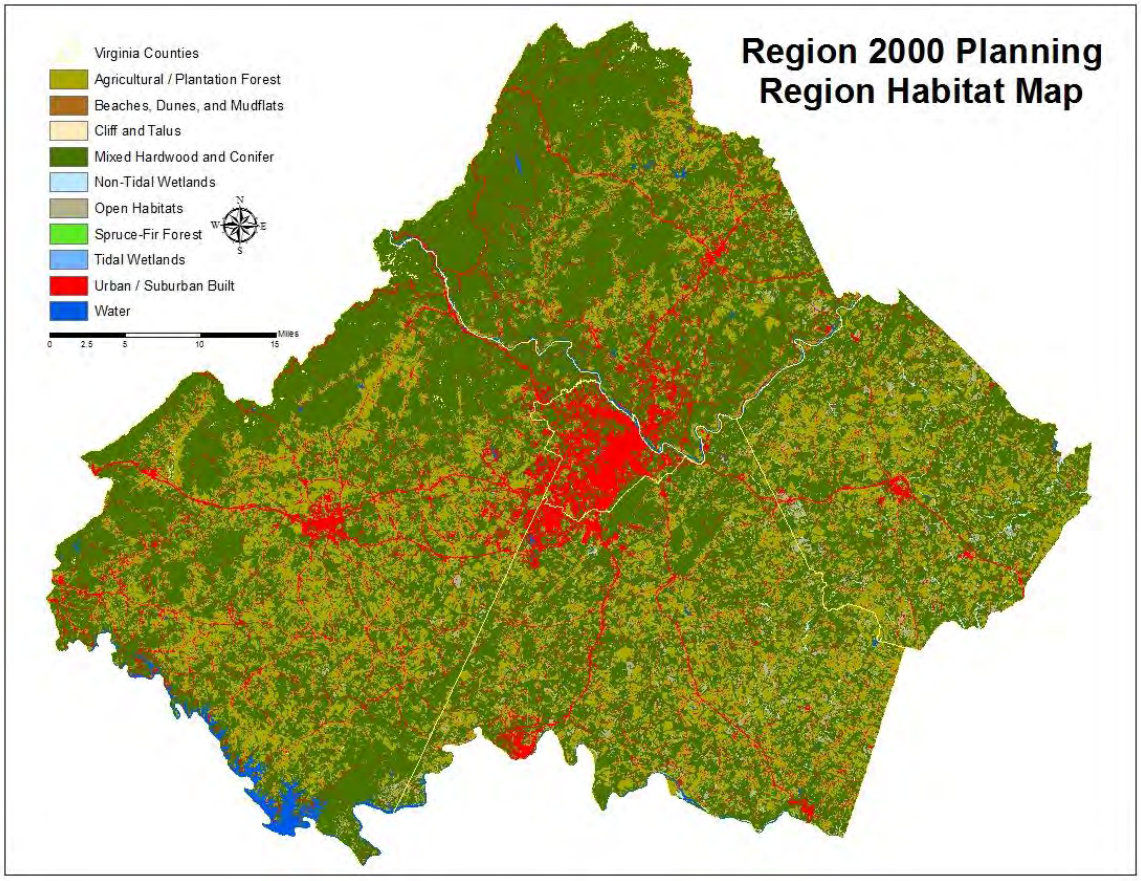

Figure 2. Region 2000 Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 74 are believed to either occur, or have recently occurred, within the Region 2000 Planning Region (Appendix A). Of these 75 species, ***34 SGCN are dependent upon habitats provided within the Region 2000 Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 33 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	3
Ic	1
IIa	3
IIc	5
IIIa	3
IIIb	1
IIIc	2
IVa	9
IVb	5
IVc	2

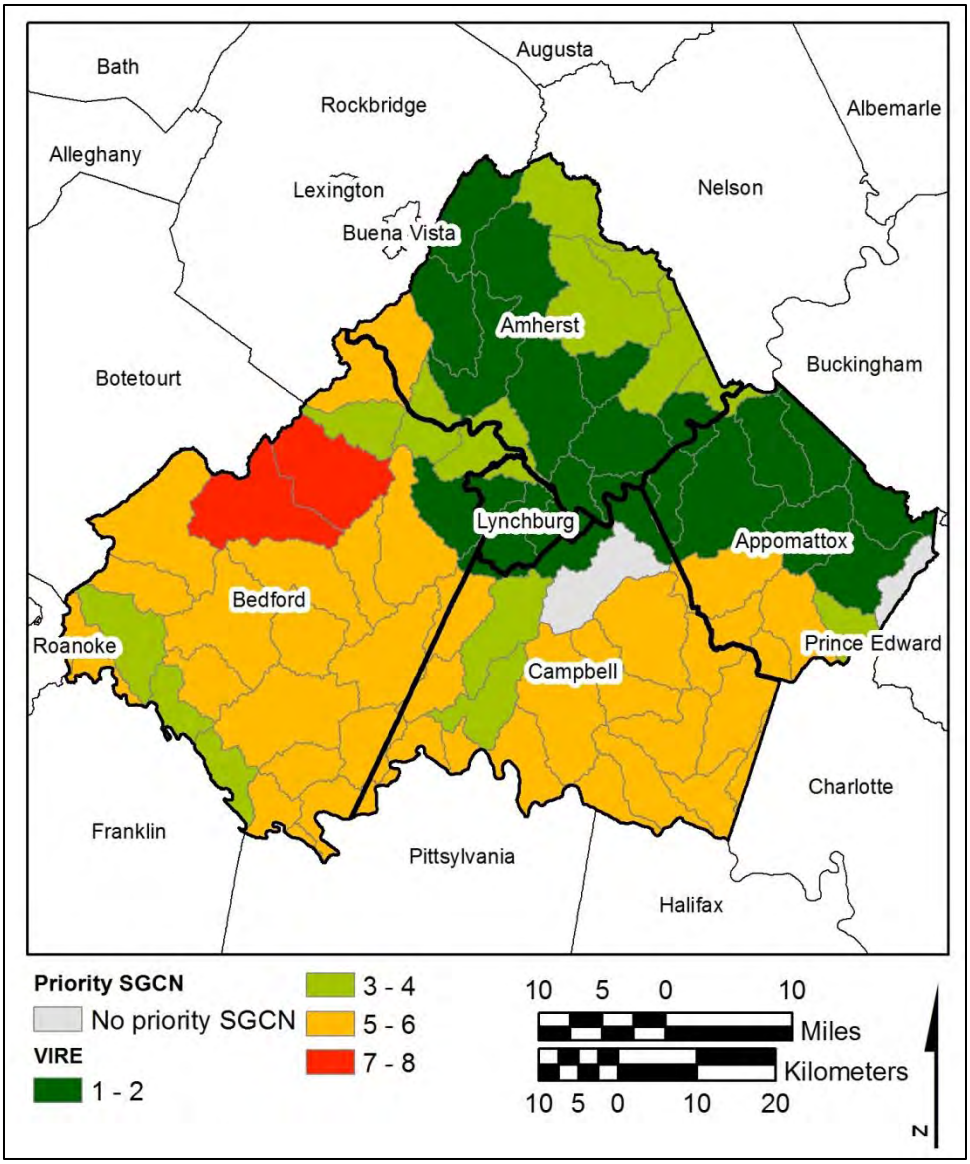

Figure 3. Priority SGCN Density in the Region 2000 Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Region 2000 Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*	Hardwood and mixed forests containing fish-free breeding ponds
Amphibian	FS	I	c	Peaks of Otter salamander	*Plethodon hubrichti*	Site specific - utilizing various forest, rhododendron thickets, and forested talus slopes with deep moist soils
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and border
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.
Bird		III	a	Eastern whip-poor-will	*Caprimulgus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		I	a	Glossy ibis	*Plegadis falcinellus*	Wooded wetlands close to the coast
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons

Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps
Bird	ST	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	FS	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*	Caves with clean abundant water flowing through the system
Fish	FS	III	c	Bigeye jumprock	*Moxostoma ariommum*	Moderate gradient streams with unsilted rubble, boulder, or rock outcrop substrate
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	ST	II	c	Carolina darter	*Etheostoma collis*	Very slow moving water with sand or gravel substrates flowing through wooded areas or pastures
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*	Warm large creeks, streams, and small rivers with low gradient and typically clear water
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*	Moderate to high gradient streams with rock, gravel, or sand substrates
Fish	FESE	II	a	Roanoke logperch	*Percina rex*	Warm clear stream and rivers with low to moderate gradient and unsilted substrate
Insect		II	c	Appalachian snaketail	*Ophiogomphus incurvatus alleghaniensis*	This species utilizes spring fed streams with mud/ gravel bottoms
Insect	FS	II	c	Gammon's riffle beetle	*Stenelmis gammoni*	No specific habitats have been identified but IUCN indicates this species requires clean clear mountain streams
Insect	FS	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens/ oak savanna and other open sunny habitats
Insect	FS	II	c	Tawny crescent	*Phyciodes batesii batesii*	Dry habitats including clearings, open woods and roadsides containing wavy-leaved asters
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*	Forest generalist but require soils suitable for digging

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Region 2000 Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national forests to state wildlife management areas, parks, and forests to conservation easements. Significant conservation assets, in terms of size, include:

- George Washington and Jefferson National Forests,
- Featherfin Farm Wildlife Management Area,
- Holliday Lake State Park,
- Smith Mountain Lake State Park,
- Holliday Lake State Park,
- Bourassa State Forest,
- Appomattox Buckingham State Forest,
- Bourassa State Forest, and
- Buffalo Creek Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

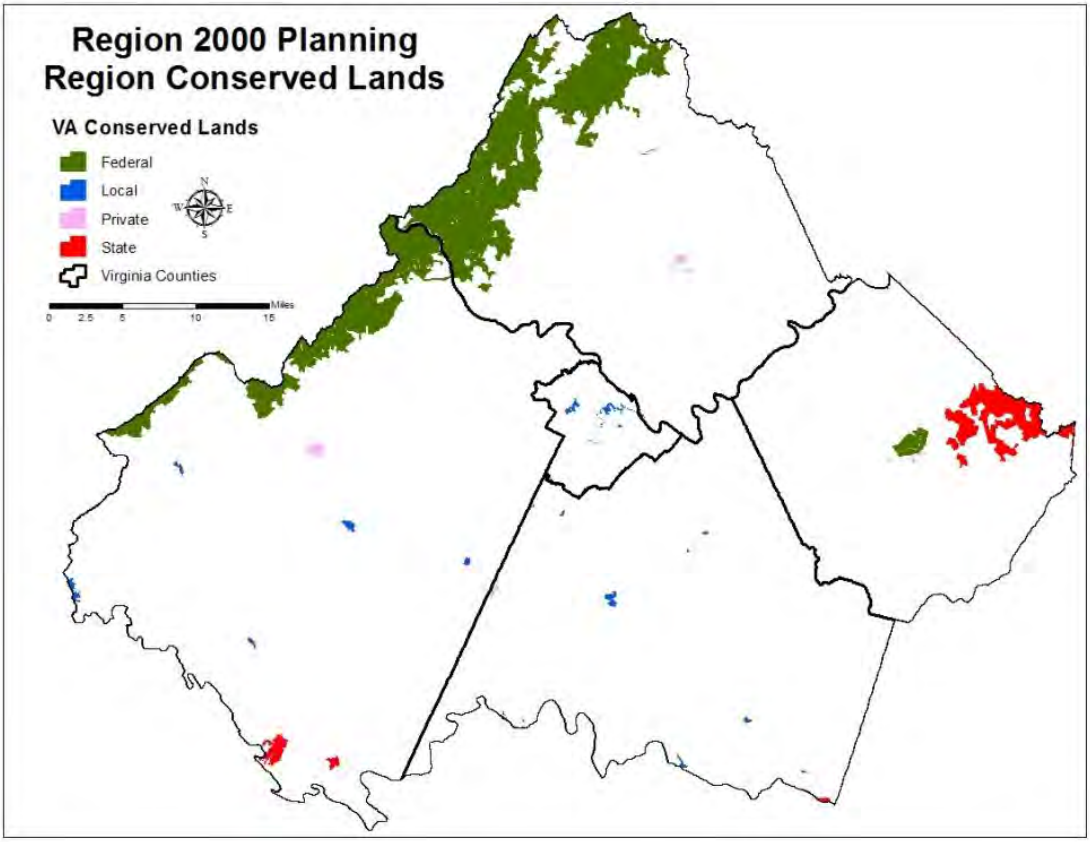

Figure 4. Conservation Lands in Region 2000 Planning Region (DCR 2014).

These properties serve as an important component of wildlife conservation efforts on within Region 2000 Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. There may be concern over the economic and social impacts of putting more lands into conservation, but many of these areas provide recreation and ecotourism benefits (DCR 2013a; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Region 2000 Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the Region 2000 Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions to Wildlife and Habitats in the Region 2000 Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Region 2000 Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for Region 2000 Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watersheds with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish riparian buffers along streams and incorporating riparian buffers into land use planning and management; 2) Reforest highly erodible pasture and croplands; 3) Establish permanent vegetative cover on critical areas; 4) Fence livestock out of streams and provide alternative water sources; 5) Utilize cover crops and no-till techniques on crop lands; 6) Improve pasture management; 7) Repair failing septic systems and eliminating "straight pipes;" 8) Establish vegetative buffers, bioretention basins, rain gardens, and other mechanisms to slow the flow of runoff into watersheds; 9) Implement BMPs to limit fecal contamination from private kennels; 10) Continue to identify impaired waters within the planning region; 11) Restore aquatic connections; 12) Monitor and address invasive species impacts; and 13) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Beaver Creek, Blackwater Creek, Fishing Creek, James River, Judith Creek, Big Hounds Creek, Upper Nottoway River, Big Otter Creek, Buffalo Creek, unnamed tributary, Cub Creek, Turnip Creek, Falling River, Piney River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

	management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.			
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter river systems	Areas supporting SGCN that are not already protected

Maintain and Restore Wetland Habitats

A very small percentage of the Region 2000 Planning Region is wetland habitat. Non-tidal wetlands make up approximately 0.4 percent (5,585 acres) of the planning region (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for species like the glossy ibis and green heron.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that result in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation through direct consumption or outcompeting for resources. Examples of invasive species affecting these non-tidal wetlands include: purple loosestrife and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change, such as in summer months where droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Region 2000 Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to

reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Region 2000 Planning Region include those wetlands that would allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5)(Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). Some of the highest priority areas for conservation are adjacent to already protected areas, providing a potential opportunity for expansion. The areas with the highest potential for restoration area spread throughout the planning region.

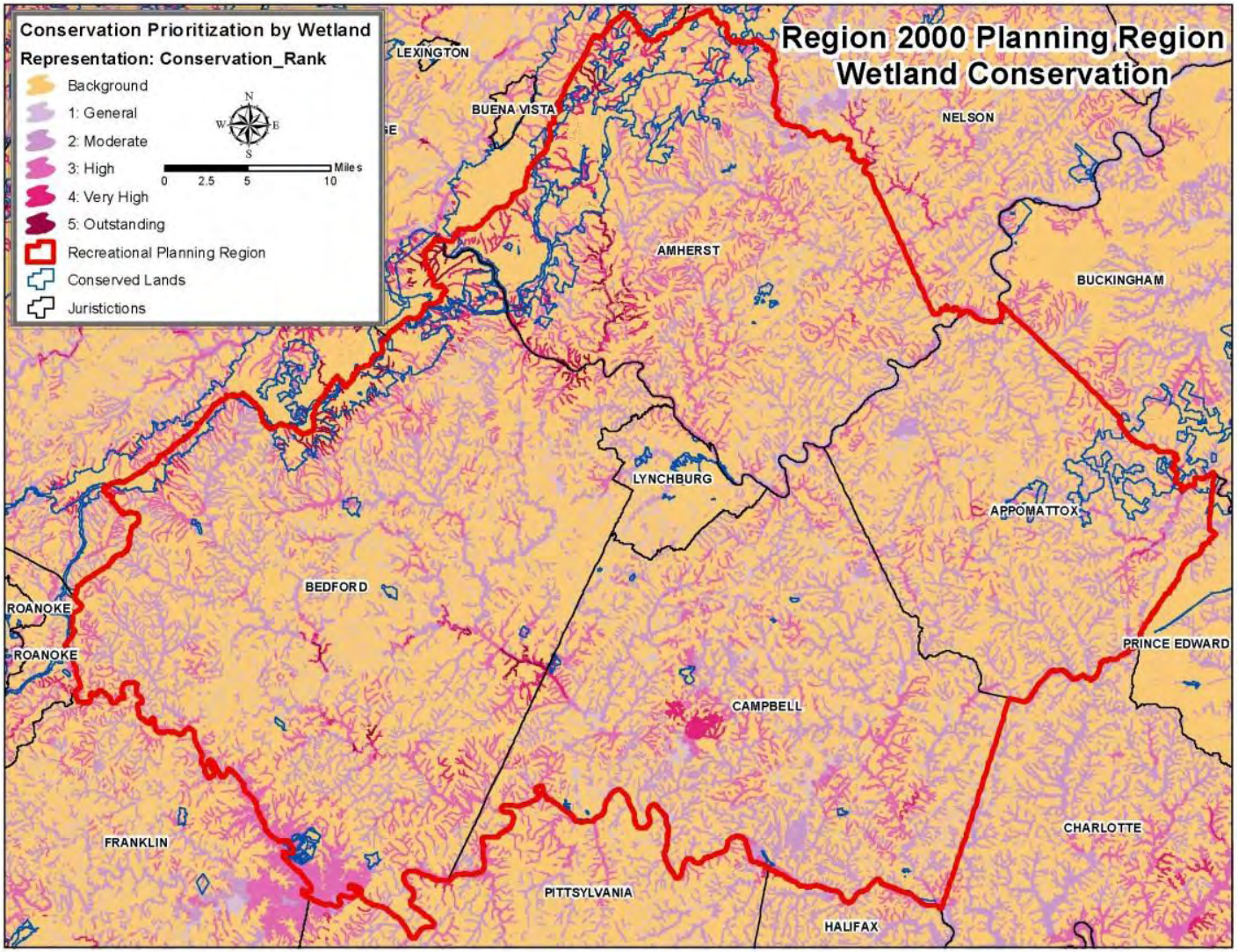

Figure 5. Wetland Conservation Priority Areas in Region 200 Planning Region (Weber and Bulluck 2014).

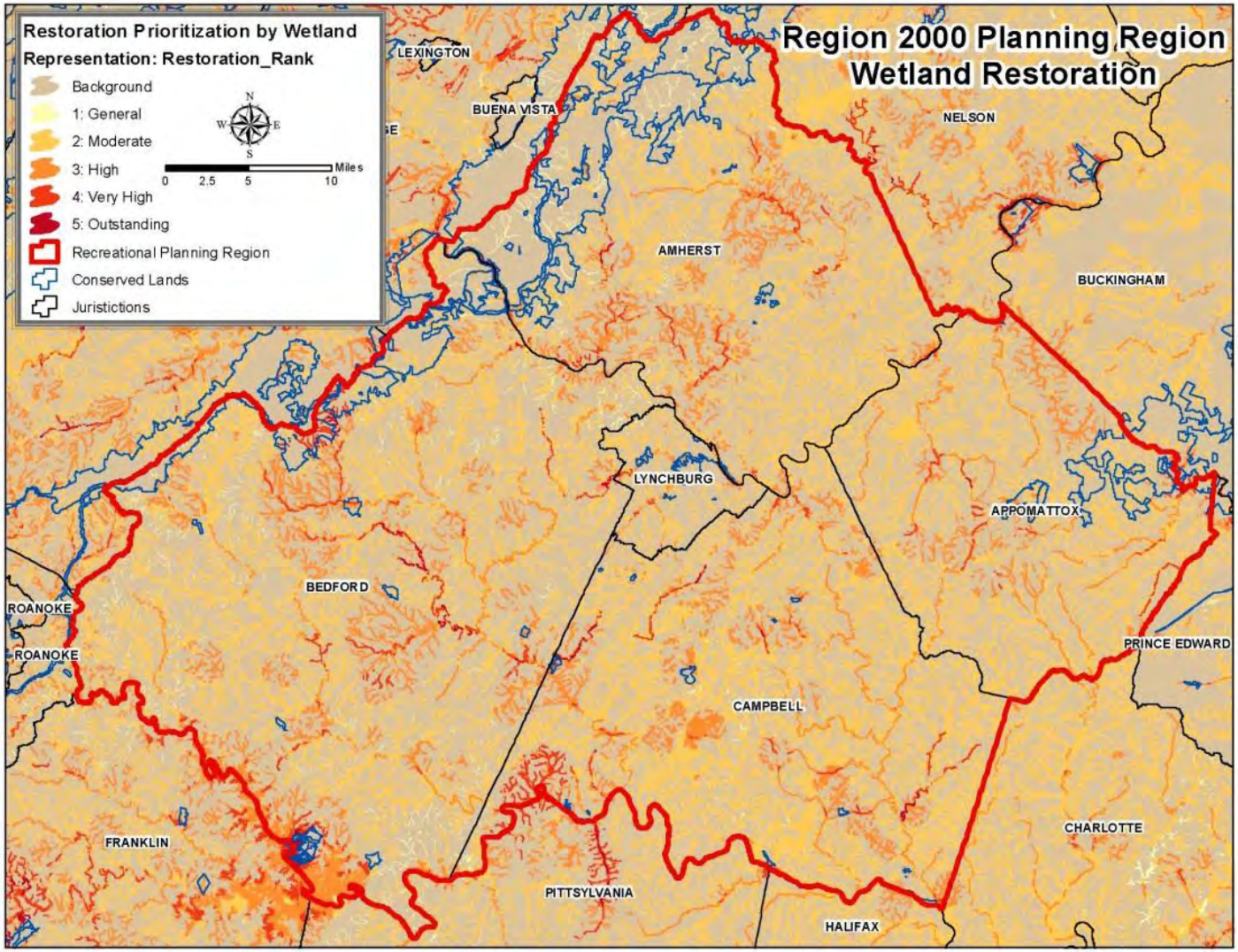

Figure 6. Wetland Restoration Priority Areas in Region 2000 Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and enhancement of wetlands by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Region 2000 Planning Region include cold and warm water rivers, streams, and creeks. The primary watersheds are the James, Roanoke, and Appomattox Rivers. Approximately 19,500 acres (1.4 percent) of the planning region are considered aquatic (Anderson et al. 2013). Priority SGCN that depend on these habitats include many invertebrate and fish species, such as the Gammon's riffle beetle, bigeye jumprock, riverweed darter, Roanoke hog sucker, and Roanoke bass.

Threats

Aquatic and riparian habitats within the Region 2000 Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Region 2000 Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014a). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although Region 2000 Planning Region has areas with a high percentage of impervious surface, the majority of the planning region has a low percentage of impervious surface cover (Figure 7).

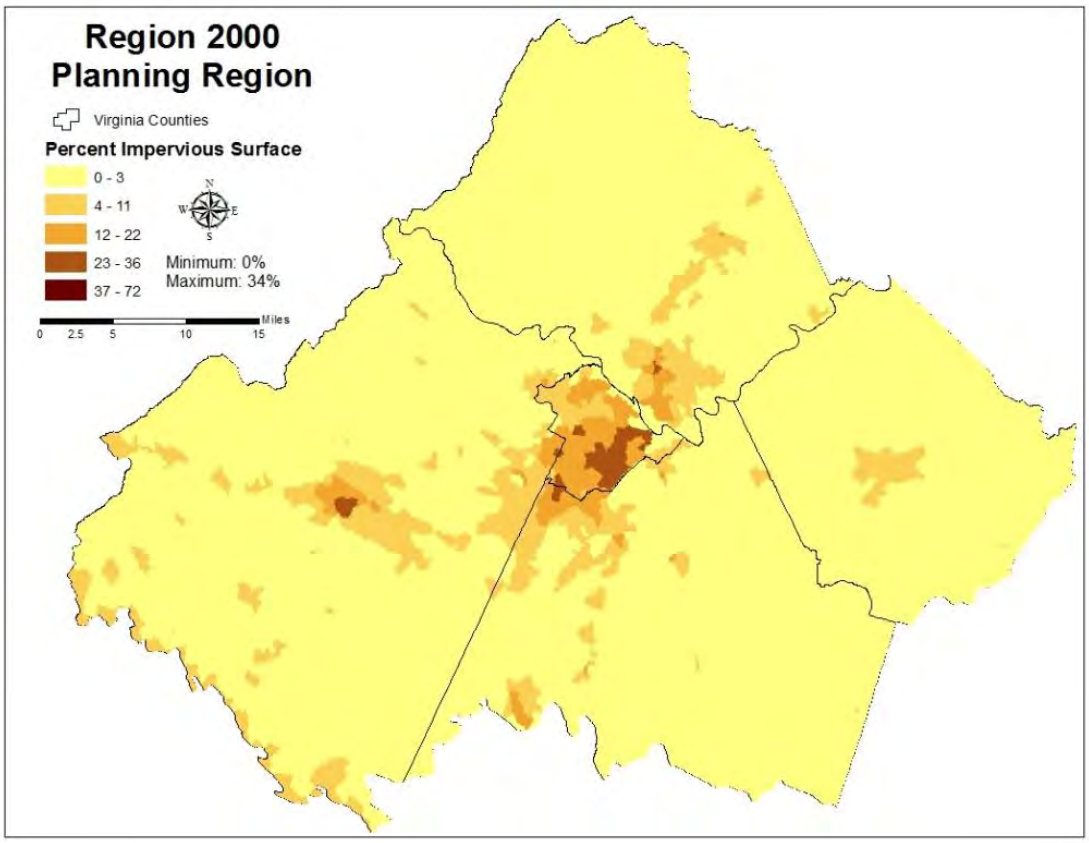

Figure 7. Impervious Surface Cover in Region 2000 Planning Region (SARP 2014).

3. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

4. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

5. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014).

6. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Beaver Creek, Blackwater Creek, Fishing Creek, James River, Judith Creek, (MapTech 2010); Big Hounds Creek, Upper Nottoway River (MapTech 2005); Big Otter Creek (Big Otter IP Steering Committee 2006); Buffalo Creek and unnamed tributary, Cub Creek, Turnip Creek (MapTech 2009); Falling River (MapTech 2008); and Piney River (DEQ 2014b) (Figure 8).

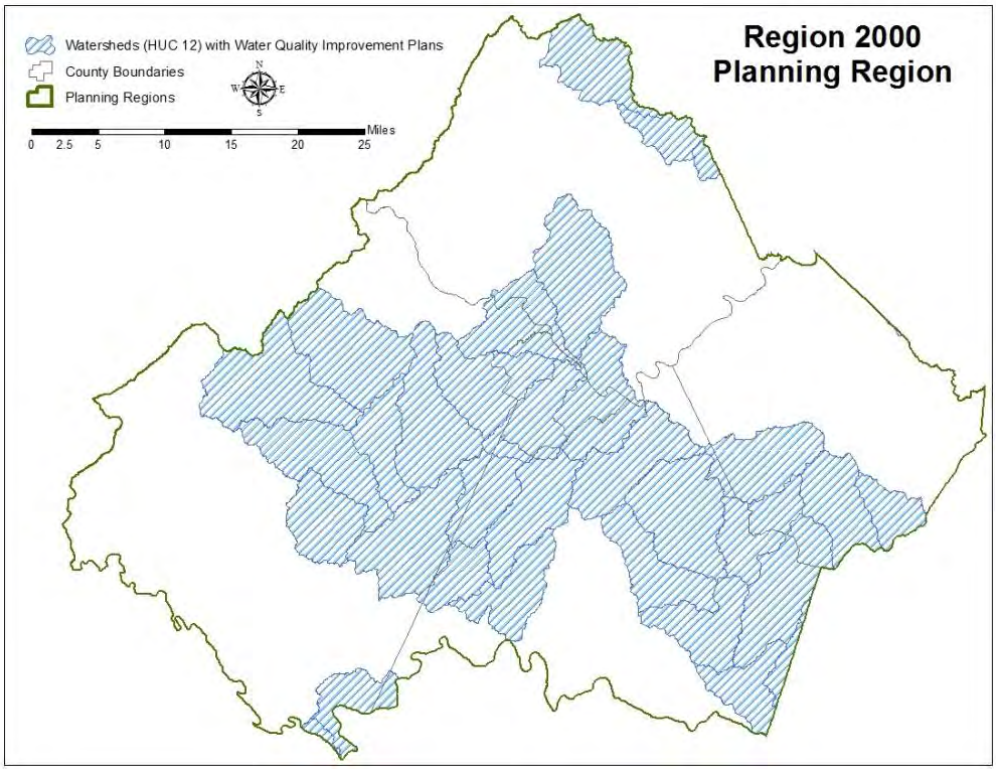

Figure 8. Watersheds with Water Quality Improvement Plans.

These watersheds are designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing riparian buffers along streams and incorporating riparian buffers into land use planning and management
- Reforesting highly erodible pasture and croplands;
- Establishing permanent vegetative cover on critical areas;
- Fencing livestock out of streams and providing alternative water sources;
- Utilizing cover crops and no-till techniques on crop lands;
- Improving pasture management to limit overland flow of water contaminated with fecal matter;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams;
- Establishing vegetative buffers, bioretention basins, rain gardens, and other mechanisms to slow the flow of runoff into watersheds; and

- Implement BMPs to limit fecal contamination from private kennels.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

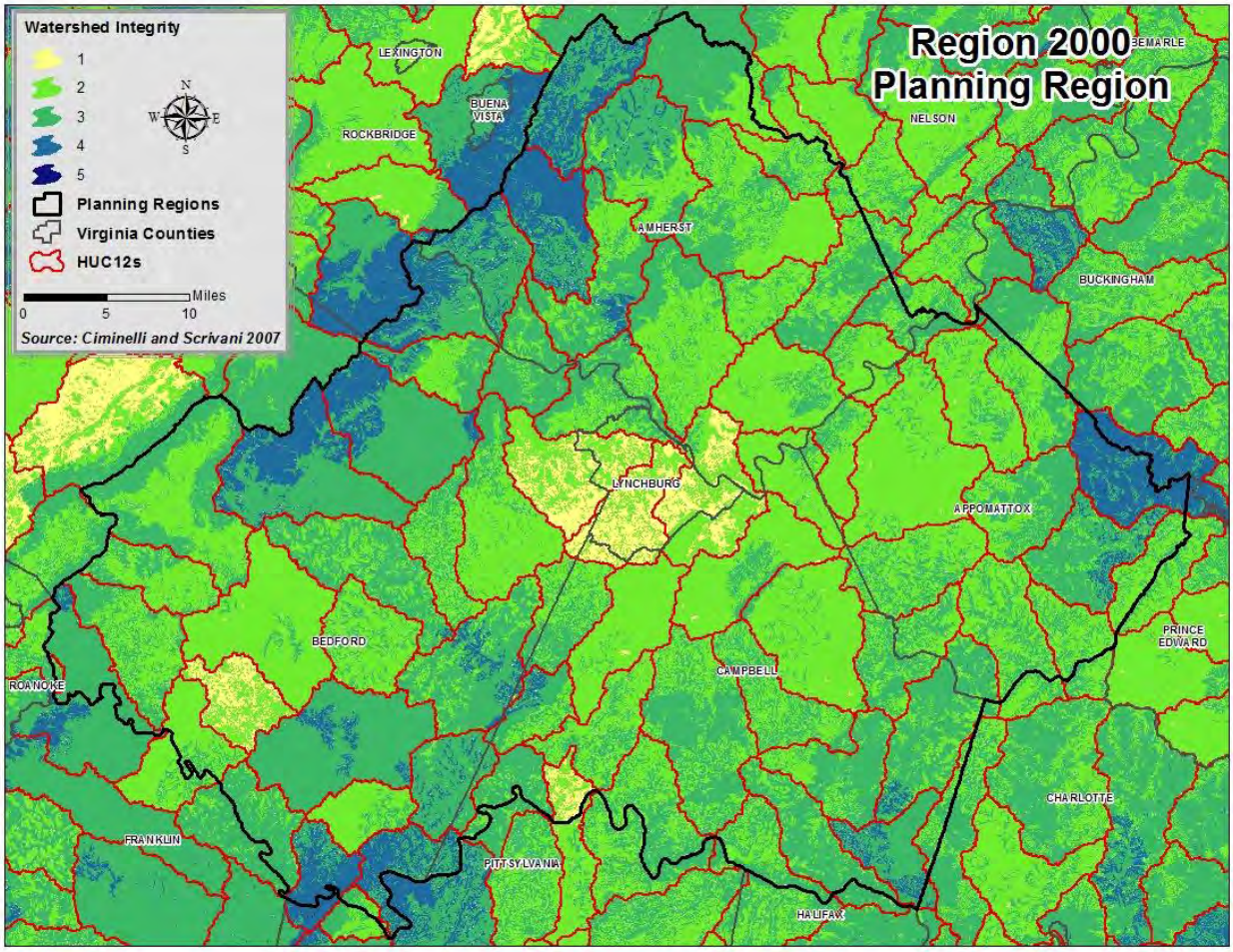

Figure 9. Watershed Integrity Model for Region 2000 Planning Region (Cimenellio Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Region 2000 Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). The NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

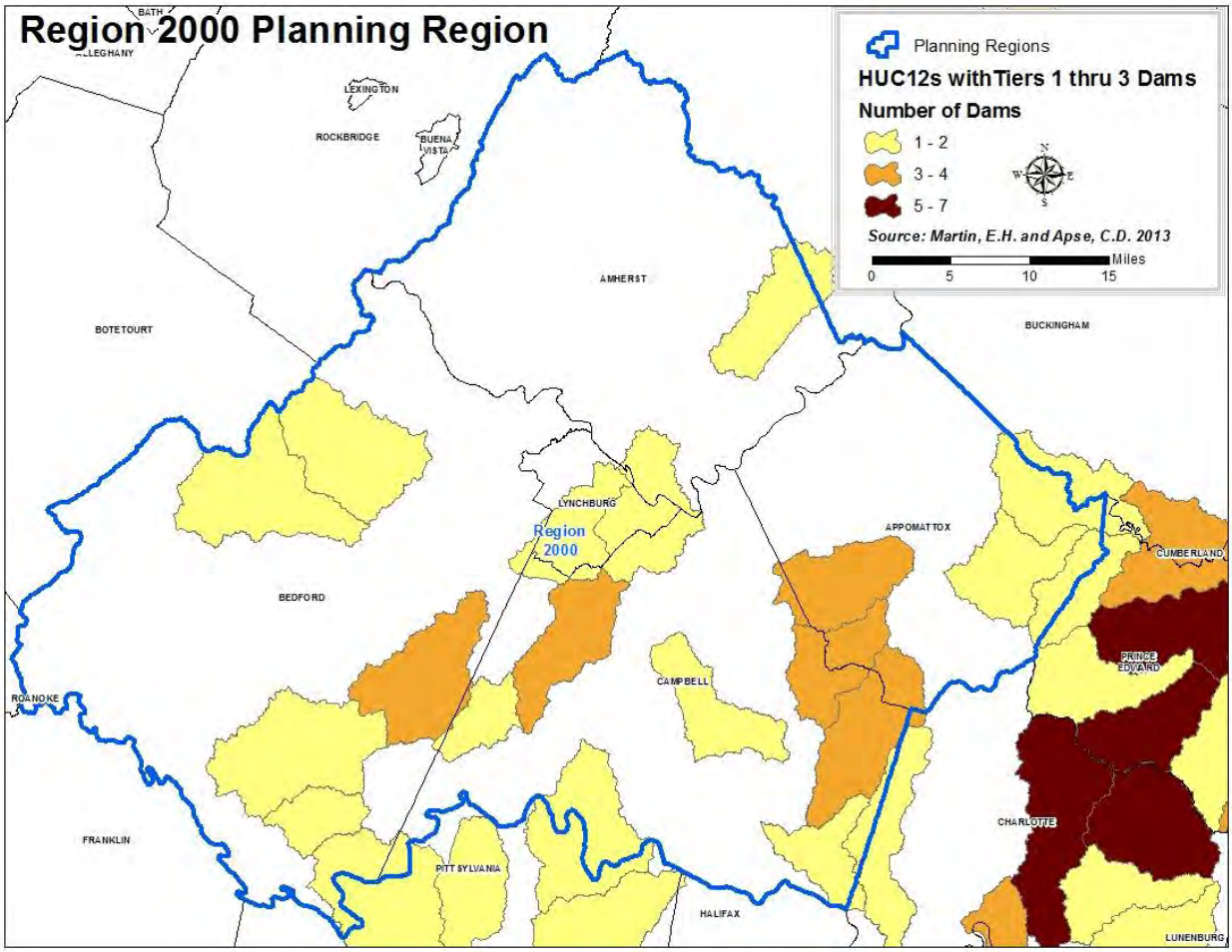

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Region 2000 Planning Region include monitoring and addressing invasive species impacts and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up over half of the Region 2000 Planning Region and are important for a broad range of species (Table 4). Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. These forests help protect water resources within the region and provide habitat for species such as the mole salamander, Peaks of Otter salamander, and Southeastern crowned snake, among others.

Table 4. Forest Acreage Totals in the Region 2000 Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Spruce Fir	8.01	0.00%
Mixed Hardwood and Conifer	825,226.39	60.08%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Region 2000 Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the hemlock wooly adelgid (DOF 2014).

3. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates deer populations in Amherst and Bedford Counties need to be reduced in order to meet a variety of social and ecological goals (DGIF 2015). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. In many cases, deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive species are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

4. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the Region 2000 Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Development of the Bacterial Total Maximum Daily Load Implementation Plan for Cub Creek, Turnip Creek, Buffalo Creek, and unnamed tributary of Buffalo Creek in Appomattox, Campbell, and Charlotte Counties, Virginia* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Buffalo Creek, Cub Creek, and Turnip Creek watersheds to help decrease sediment run off as well as

provide wildlife habitat (MapTech 2009). Similar actions are recommended for the Piney Creek watershed (DEQ 2014).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times and will be similarly addressed in the 2015-2024 Deer Management Plan (DGIF 2015). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Region 2000 Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult recently available climate data through DGIF as well as the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 32,000 acres (2.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than three percent), these habitats are important for priority SGCN, including the tawny crescent and Persius duskywing butterfly.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more prone to drought. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate); • Photos documenting changes in shoreline as restored

	vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Region 2000 Planning Region, priority conservation opportunities include:

- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN REGION 2000 PLANNING REGION

Complete SGCN list for the Region 2000 Planning Region (SGCN=74). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Amphibian	**FS**	I	c	Peaks of Otter salamander	*Plethodon hubrichti*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*

Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*
Fish		III	a	American eel	*Anguilla rostrata*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect		II	c	Appalachian snaketail	*Ophiogomphus incurvatus alleghaniensis*
Insect	**FS**	II	c	Dotted skipper	*Hesperia attalus slossonae*
Insect	**FS**	II	c	Gammon's riffle beetle	*Stenelmis gammoni*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*

Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

21. Richmond Regional Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG) that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very high Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

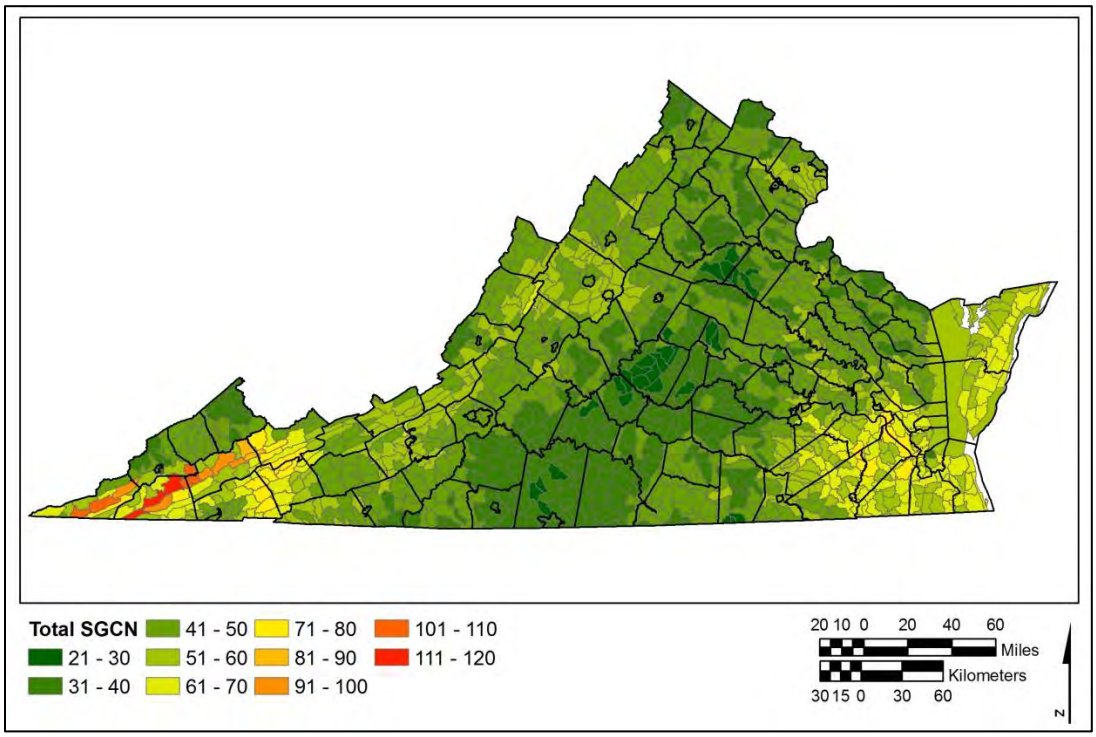

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

RICHMOND REGIONAL PLANNING REGION SUMMARY OVERVIEW

The Richmond Regional Planning Region consists of 1,410,063 acres (2,203 square miles) and includes the counties of Charles City, Chesterfield, Goochland, Hanover, Henrico, New Kent, and Powhatan, the town of Ashland, and the city of Richmond. The human population in this planning region is estimated to be over 1,050,000 people (U.S. Census Bureau 2015). Most counties are projected to see a relatively significant increase in population size by 2030 (between 20 and 55 percent), while the city of Richmond will likely experience a decrease of approximately 9 percent (Weldon Cooper Center 2012).

Areas that are less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow. This planning region is especially important to the conservation of the fine-ribbed striate snail which is found only within forests this planning region. The region is also important to the glossy crayfish snake, eastern pond mussel, rare skipper, and the eastern slender glass lizard. Open habitats support Rafinesque's eastern big-eared bat. The planning region also includes a variety of other habitats such as mature mixed hardwood forests, young forests, retired agricultural land, tidal and non-tidal wetlands, and tidally influenced streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

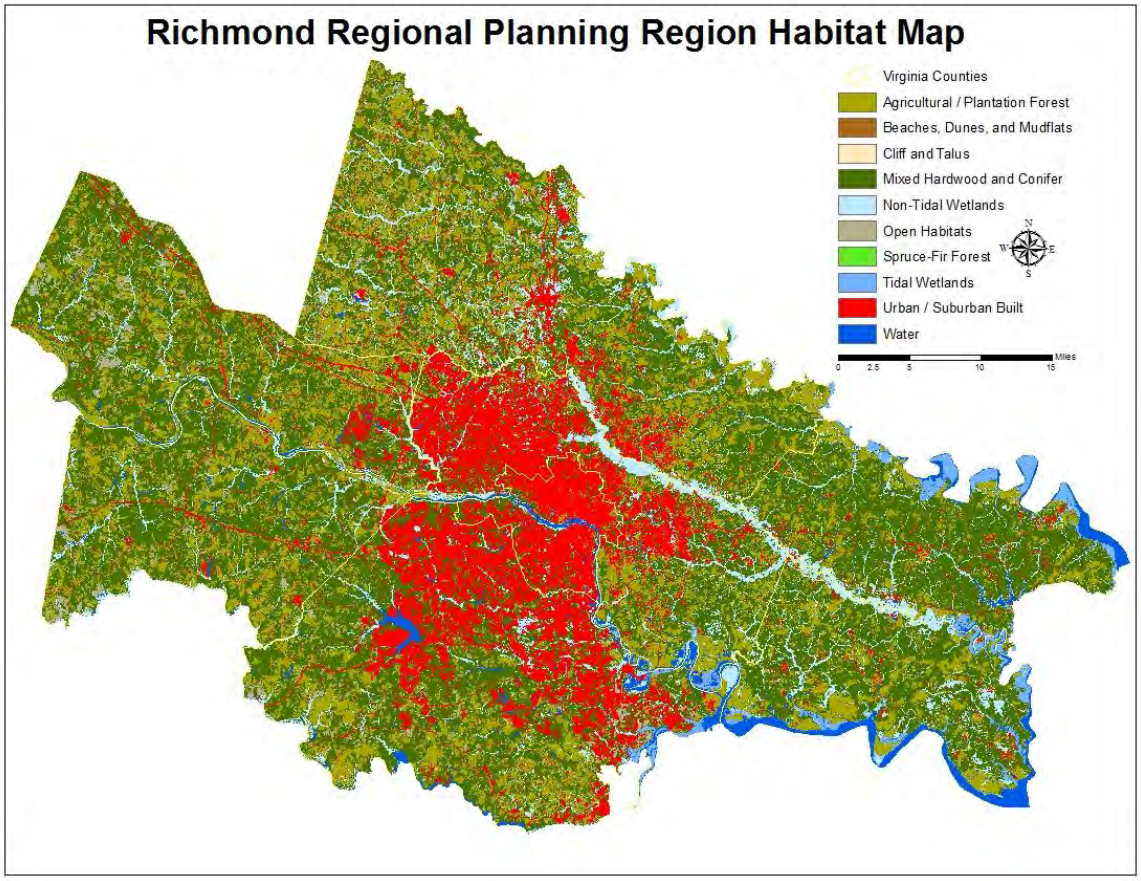

Figure 2. Richmond Regional Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 100 are believed to either occur, or have recently occurred, within the Richmond Regional Planning Region (Appendix A). Of these 100 species, ***51 SGCN are dependent upon habitats provided within the Richmond Regional Planning Region (Table 2). These species constitute the priority SGCN for the Richmond Regional Planning Region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 51 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	3
Ib	2
IIa	1
IIc	1
IIIa	4
IIIb	3
IIIc	3
IVa	20
IVb	7
IVc	7

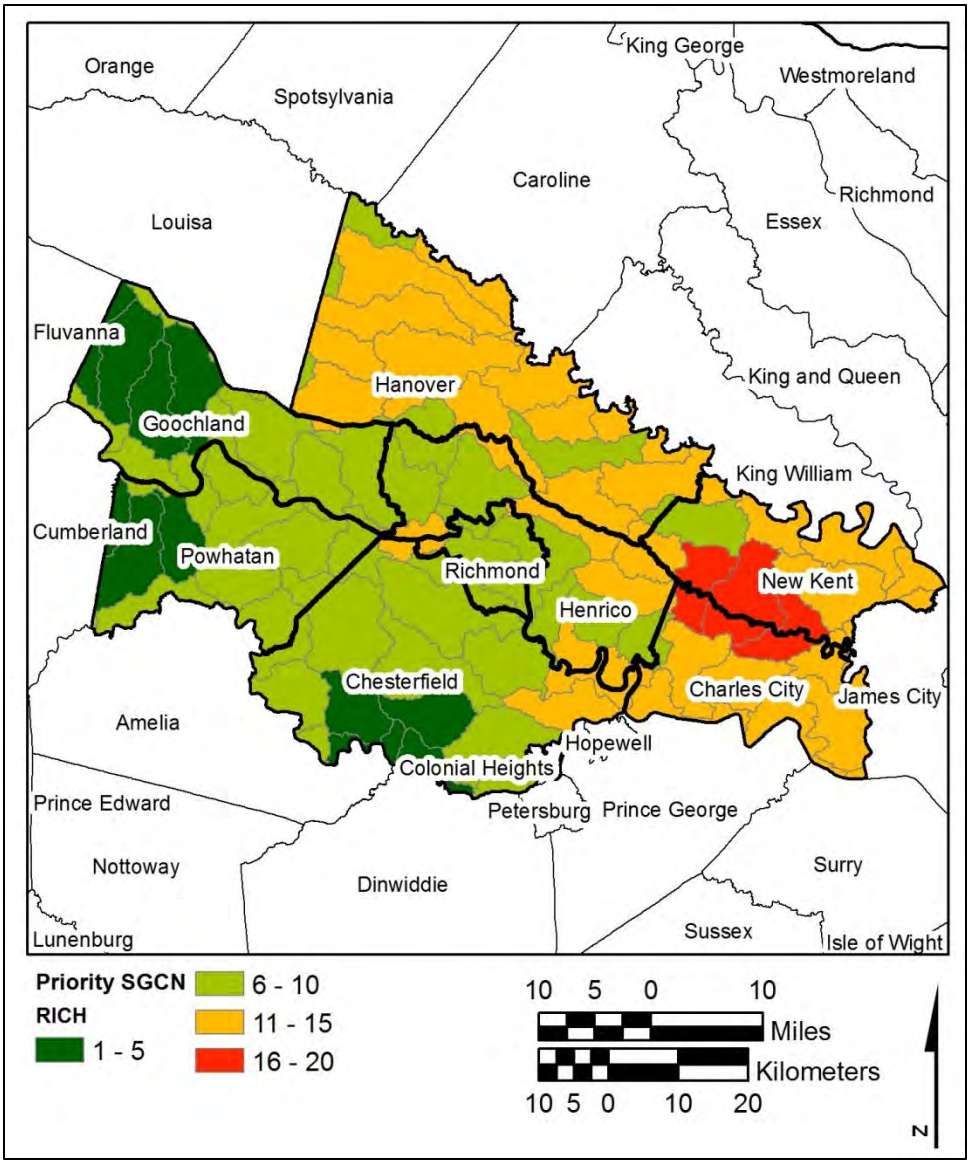

Figure 3. Priority SGCN in the Richmond Regional Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Richmond Regional Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*	Freshwater wetlands with sphagnum moss
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*	Forest and upland habitat generalist but require soils suitable for digging
Amphibian		IV	a	Greater siren	*Siren lacertina*	Tolerates a variety of warm aquatic habitats with abundant vegetation
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*	Most abundant in wetlands within pine savannah habitats
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*	Migratory with weak habitat associations in Virginia
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats
Bird		III	a	Eastern whip-poor-will	*Antrostomus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate

Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird		III	b	Least bittern	*Ixobrychus exilis*	Freshwater marshes
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*	Human structures in the east and cliff sites in the west
Fish		IV	a	Alewife	*Alosa pseudoharengus*	Migratory
Fish		IV	c	American brook lamprey	*Lampetra appendix*	Requires clear flowing water but can tolerate a range of temperatures and substrates
Fish		IV	a	American shad	*Alosa sapidissima*	Large unfragmented migratory rivers for spawning
Fish		I	b	Atlantic sturgeon	*Acipenser oxyrinchus*	Migratory. Utilize variety of aquatic and marine habitats
Fish		I	a	Bridle shiner	*Notropis bifrenatus*	Slow clear water with aquatic vegetation
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*	Moderately acidic creeks, streams, and swamps
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*	Warm small streams with slow flows and sand/ silt substrates
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*	Swamps, ponds, and slow moving water
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*	Areas with moderate current and sand, rocky, or mud bottom
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*	Areas of limited currents and significant amounts of fine organic matter. Can tolerate a wide range of substrates
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*	Shallow water near stable banks with intact riparian zones and soft substrates
FW Mollusk		I	b	Virginia pigtoe	*Lexingtonia subplana*	Site specific - cool clean headwater streams with sand and gravel substrates
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*	Freshwater and brackish marsh
Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*	Riparian forests
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*	Use hollow trees as well as various types of human structures for roosting

Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*	Open mature stands of pine or pine/ hardwoods
Other Terrestrial Invertebrate		IV	c	Fine-ribbed striate	*Striatura milium*	No habitats have been identified for this species
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*	Barren
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	Upland pine habitats
Reptile		III	c	Glossy crayfish snake	*Regina rigida rigida*	Freshwater wetland generalist
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*	Riparian forest - eel obligate
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*	Forest generalist but require soils suitable for digging
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*	Freshwater swamps and marshes

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Richmond Regional Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks and forests to National Wildlife Refuges (NWR). Significant conservation assets, in terms of size, include:

- Presquile National Wildlife Refuge,
- Pocahontas State Park,
- Powhatan State Park,
- Crawford State Forest, and
- Cumberland Marsh Natural Area Preserve.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

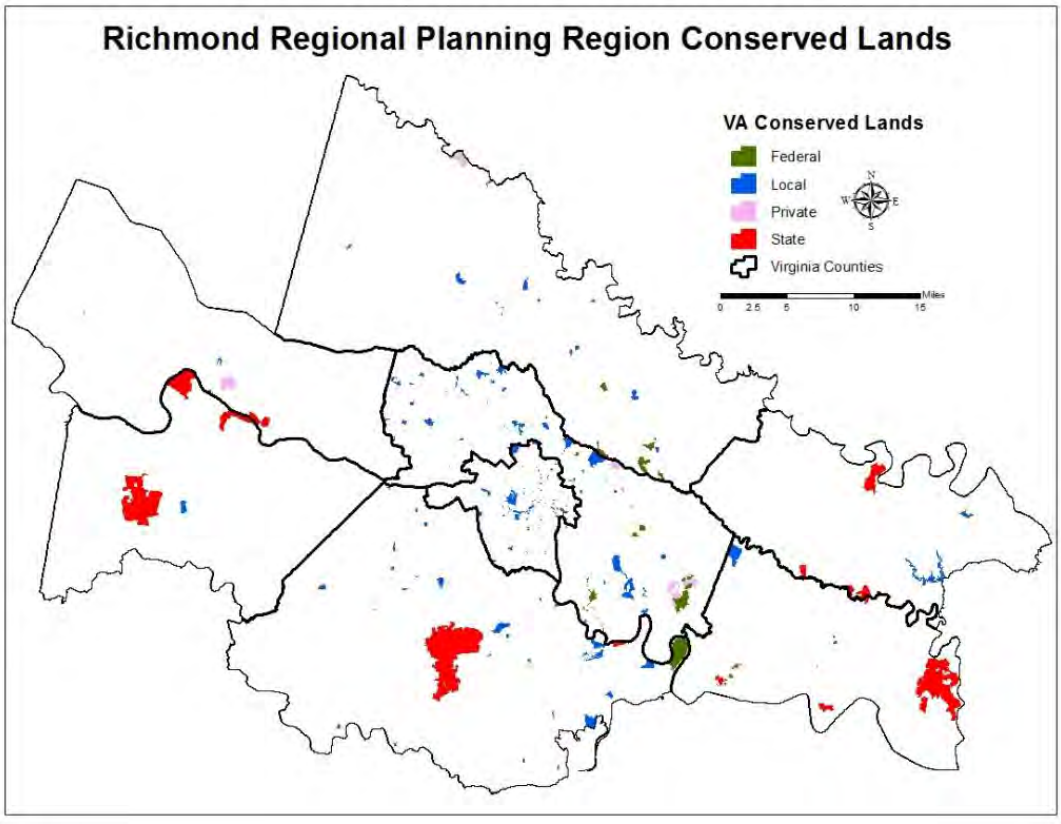

Figure 4. Conservation lands in the Richmond Regional Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Crater Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the

region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within this planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Richmond Regional Planning Region

Although Richmond Regional Planning Region is further inland than other coastal planning regions, climate change and resulting sea-level rise and storm-related events may affect areas within the region. A report published by the Virginia Institute of Marine Science (VIMS) (2013) used climate scenarios from the Intergovernmental Panel on Climate Change to determine a range of sea-level rise projections for Virginia Based on this analysis, a range of approximately 1.5 feet to over 7 feet of sea-level rise is projected in the state by 2100, and the report recommends considering a foot and a half of sea-level rise over the next 20 to 50 years for planning purposes (VIMS 2013). Tropical storm events are expected to become more intense (VIMS 2013; Staudinger et al. 2015). Sea-level rise and more intense storm events are expected to increase shoreline erosion, facilitate salt water intrusion, destroy habitats and ecological systems, and increase stormwater overflows and sewage contamination (VIMS 2013). The report also estimates, given these projections, approximately 22 miles of roads within this planning region will be vulnerable to sea-level rise (VIMS 2013; Titus 2010).

Changes in temperature and precipitation will also negatively affect habitats and SCGN in the Richmond Regional Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used by Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species, decreased water quality and dissolved oxygen content as well as changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building)

Conservation Threats and Actions for Wildlife and Habitats in the Richmond Regional Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Richmond Regional Planning Region priority SGCN and other species.

Table 1. Summary of Conservation Strategies and Actions for Richmond Regional Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Implement living shorelines where feasible; 3) Establish or enhance vegetative buffer areas inland of existing wetlands; 4) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog) to identify priority areas for conservation, acquisition, and restoration; and 5) Control invasive species.	Water quality degradation, habitat/ land use conversion, climate change, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands and areas adjacent to priority watershed that allow inland migration of wetlands
Maintain and restore aquatic systems and shorelines	1) Establish riparian buffers along streams and incorporating riparian buffers into land use planning and management; 2) Reforest erodible cropland and pasture lands; 3) Fence livestock out of streams and providing alternative water sources; 4) Repair failing septic systems and eliminating "straight pipes; " 5) Implement actions to slow runoff flowing into; 6) Establish a pet waste program; 7) Continue to identify impaired waters in the planning region; 8) Enhance aquatic connectivity; 9) Monitor and address invasive species impacts; and 10) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, stream nutrient dynamics alteration, impervious surface, land conversion/ alteration, invasive species, water withdrawals, climate change	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; Sustain sport fisheries and recreation opportunities; contribute to clean water supply	Chickahominy River and James River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing,	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and	Areas supporting SGCN that are not already

	disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	other pollutants before they enter river systems	protected

Maintain and Restore Wetland Habitats

Tidal and non-tidal wetlands are found throughout the Richmond Regional Planning Region (Table 4). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. Non-tidal marshes are the most common wetland type in this area, and they provide valuable habitats for SGCN such as the least bittern, green heron, Eastern mud salamander, rare skipper, spotted turtle, glossy crayfish snake, and a variety of other species.

Table 4. Wetland Acreage in the Richmond Regional Planning Region (Anderson et al. 2013).

Wetland Type	Acreage	Percent of Planning Region
Non-Tidal	115,666.61	8.21%
Tidal	20,760.50	1.47%

Threats

The health and quality of tidal and non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices (BMP) are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats wetlands is conversion to other uses and hardening of shorelines that can harm wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade the quality of tidal wetland habitat through damage or loss to wetland vegetation. Invasive plant species such as *Phragmites* can overtake wetlands, changing vegetative composition to a monoculture and diminishing wetland function and value. Examples of invasive species affecting non-tidal wetlands include: purple loosestrife, and exotic invertebrates.

4. Climate Change: As storms become more intense and sea levels rise (although this will be less of an issue within this planning region than other regions), more frequent inundation may also pose problems for vegetation and fish and wildlife species with low salinity tolerances along coastal areas of the planning region (VIMS 2013; CCSP 2009).

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Richmond Regional Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The Virginia Tidal Wetlands Act gives authority to the Virginia Marine Resource Commission (VMRC) to issue tidal wetland permits with the option to for local governments to assume this responsibility (DEQ 2011). The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

In certain situations, living shorelines can be a viable alternative to hardened or armored shorelines. By using native vegetation, oyster reefs, dune restoration, rock sills, bank grading, or other more natural methods living shorelines can help protect private property from erosion while also providing opportunities for wetlands to migrate as conditions change (Kane 2011; VIMS 2010). Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Richmond Regional Planning Region include those wetlands that would allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 5) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 6) (Weber and Bulluck 2014). High priority areas for conservation and restoration exist across the planning region.

Conserving and restoring wetland habitats in areas adjacent to conserved lands would have added value.

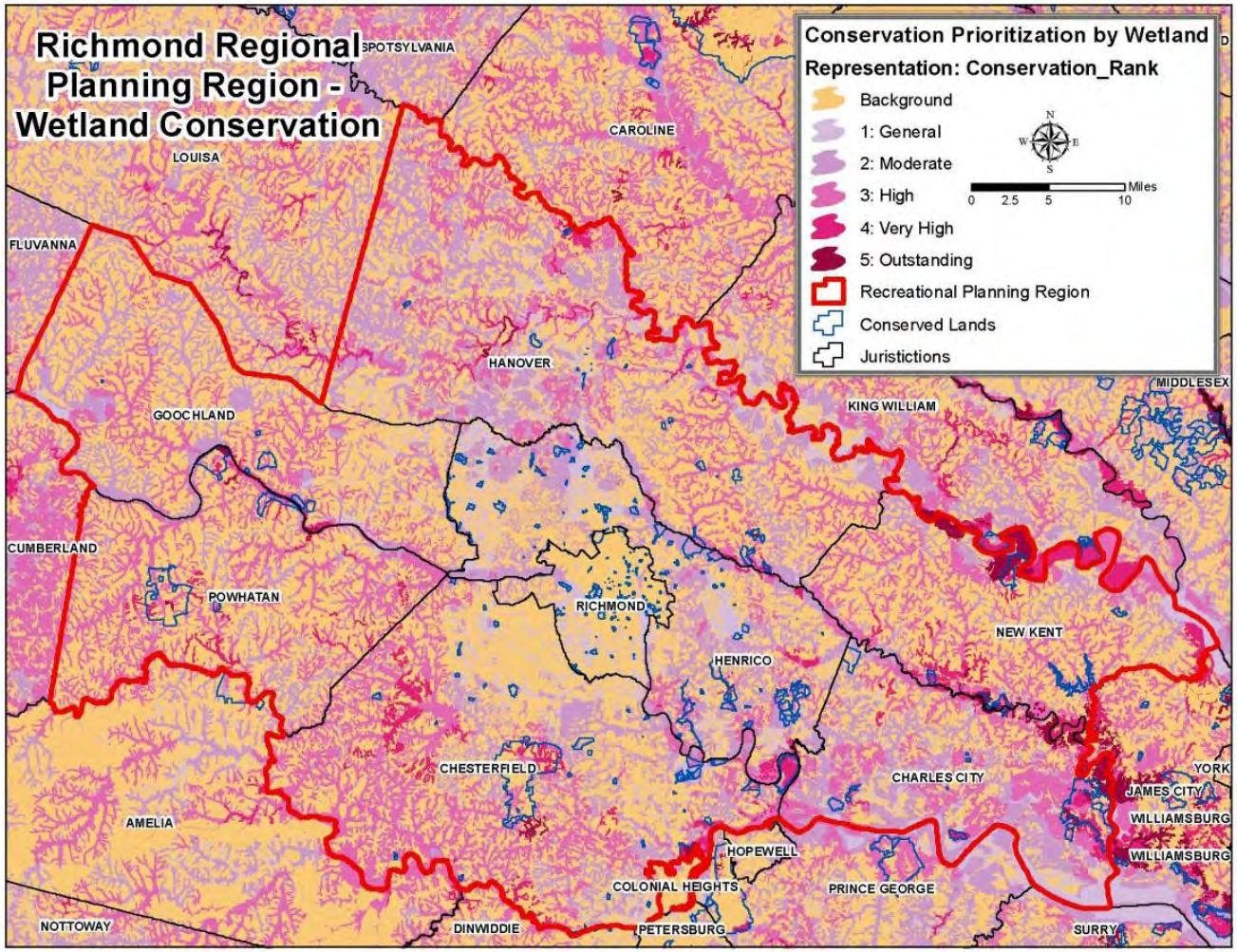

Figure 5. Wetland Conservation Priority Areas in Richmond Regional Planning Region (Weber and Bulluck 2014).

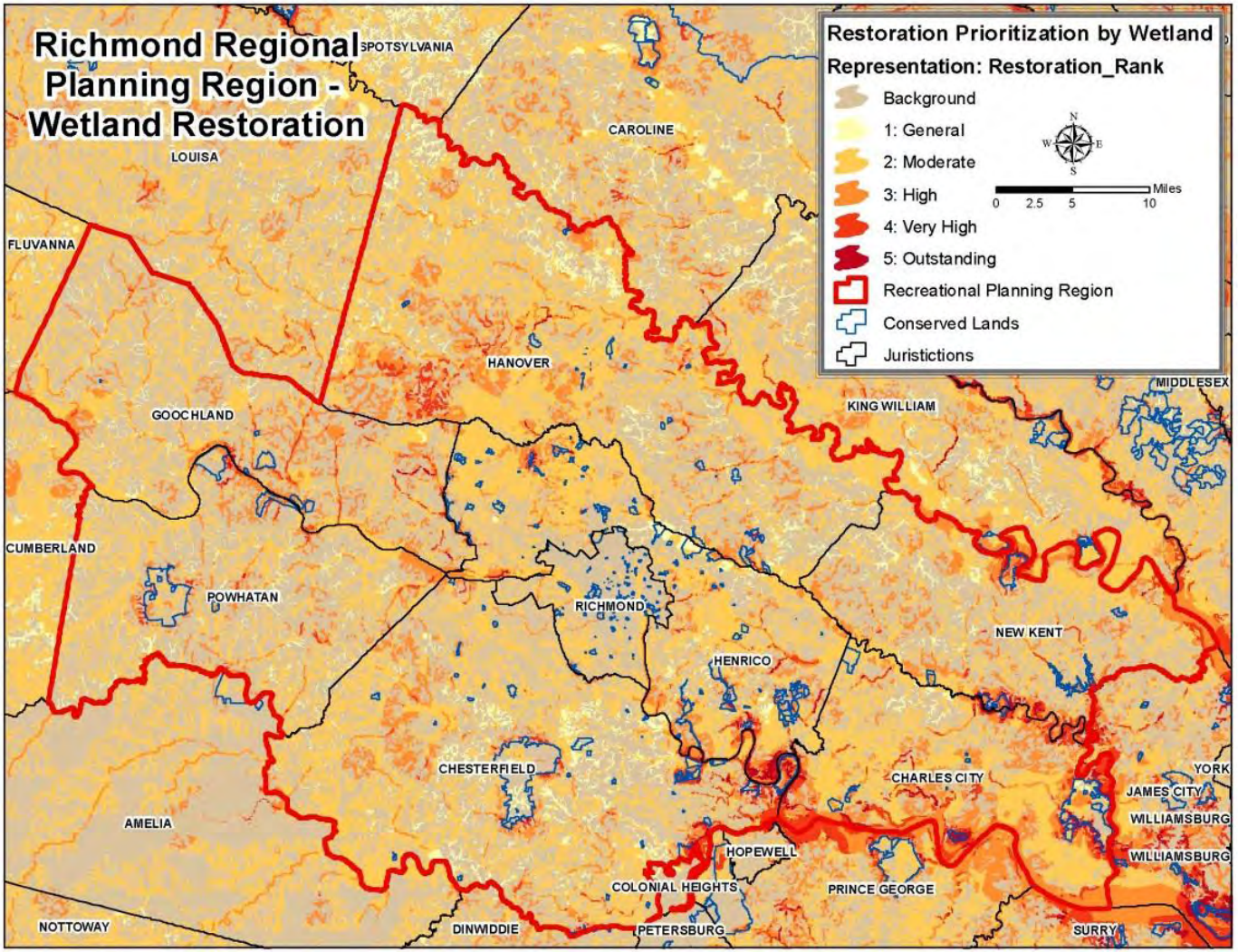

Figure 6. Wetland Restoration Priority Areas in the Richmond Regional Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions like more frequent inundation and higher salinity levels), restoration of wetlands to increase their elevation along the coast where feasible or needed, and enhancement of wetland migration by targeted restoration or acquisition in areas where wetlands may migrate (both inland and upstream).

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Richmond Regional Planning Region include tidal and non-tidal freshwater creeks and streams. The James River and York River are the primary watersheds in the region. Approximately 51,100 acres (3.6 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include eastern pond mussel, bridle shiner, mud sunfish, greater siren, Atlantic sturgeon, and alewife.

Threats

Aquatic and riparian habitats within the Richmond Regional Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Richmond Regional Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although much of the Richmond Regional Planning Region has a low

percentage of impervious surfaces, a significant amount of impervious surface exists around the urban areas (Figure 7).

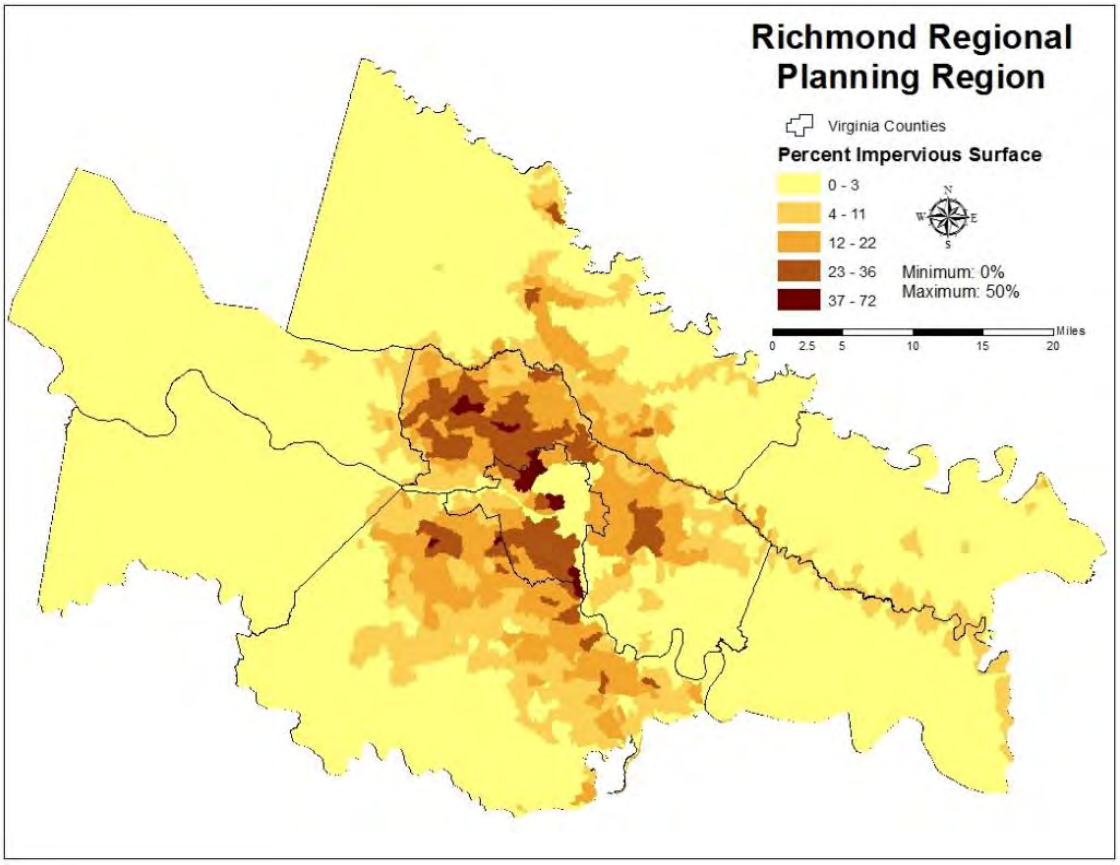

Figure 7. Impervious Surface Cover in Richmond Regional Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Richmond Regional Planning Region include invasive species such as blue catfish and carp species that either consume native species or consume aquatic vegetation, thereby altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow

rates. Additionally, over-use of groundwater could lead to saltwater intrusion into the aquifer that could degrade the quality of both subterranean and surface water.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Sea-level rise could result in inundation of some shoreline areas, while changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Water Quality Improvement Plans for Chickahominy River (MapTech 2013) and James River (MapTech 2011) (Figure 8).

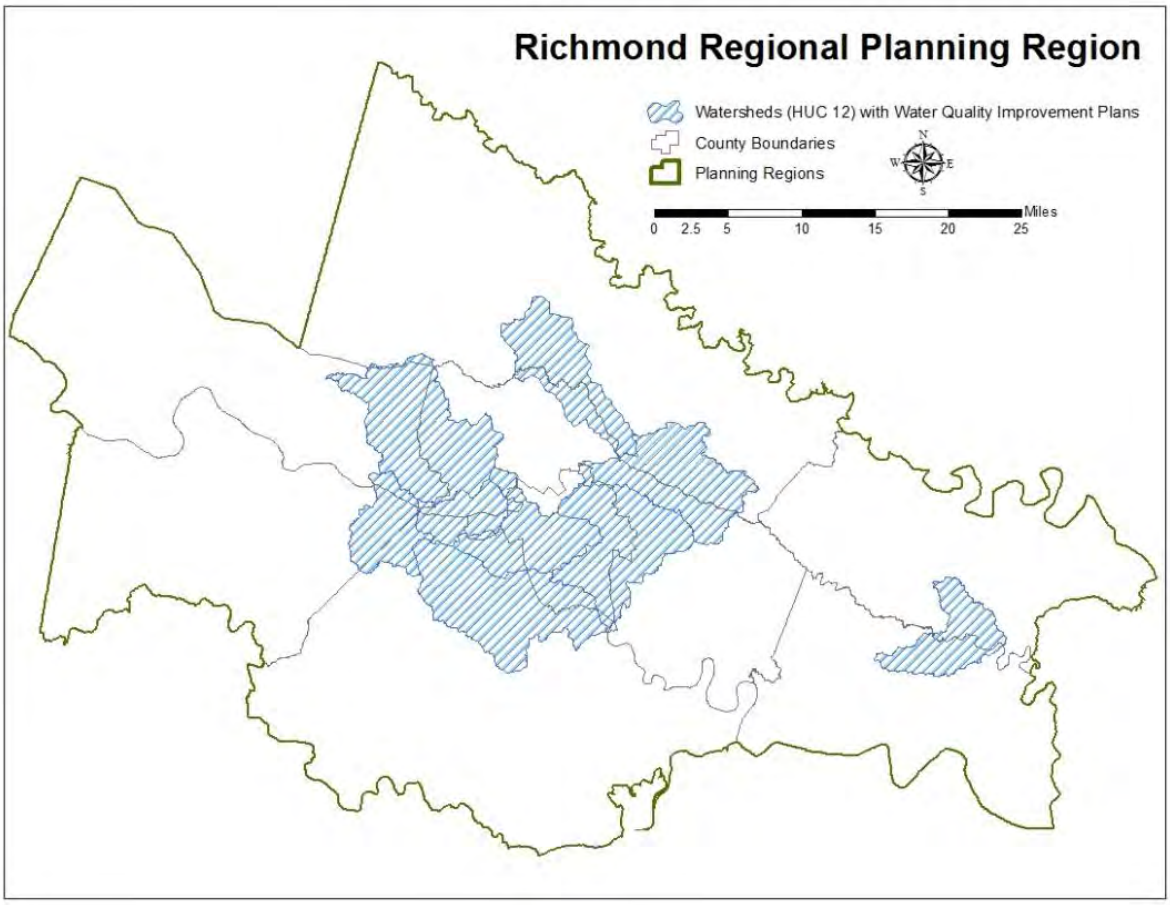

Figure 8. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing riparian buffers along streams and incorporating riparian buffers into land use planning and management;
- Reforesting erodible cropland and pasture lands;
- Fencing livestock out of streams and providing alternative water sources;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams;
- Implementing actions to slow runoff flowing into rivers such as rain gardens, bioretention basins, retention ponds, and conservation tillage; and
- Establishing a pet waste program to reduce bacterial inputs from dogs and cats.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 9).

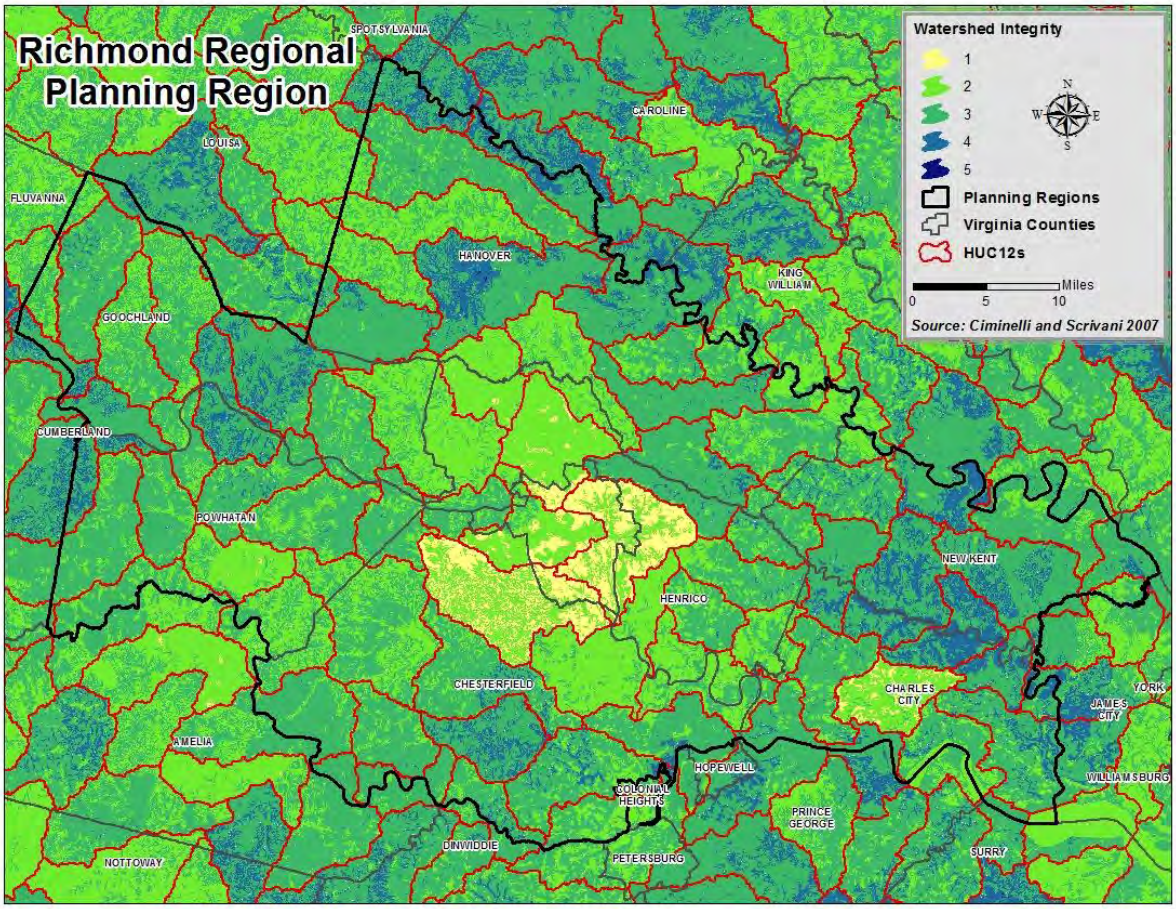

Figure 9. Watershed Integrity Model for Richmond Regional Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Reducing impervious surface by replacing with more porous materials or vegetation;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Richmond Regional Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve conditions and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 10) (Martin and Apse 2013).

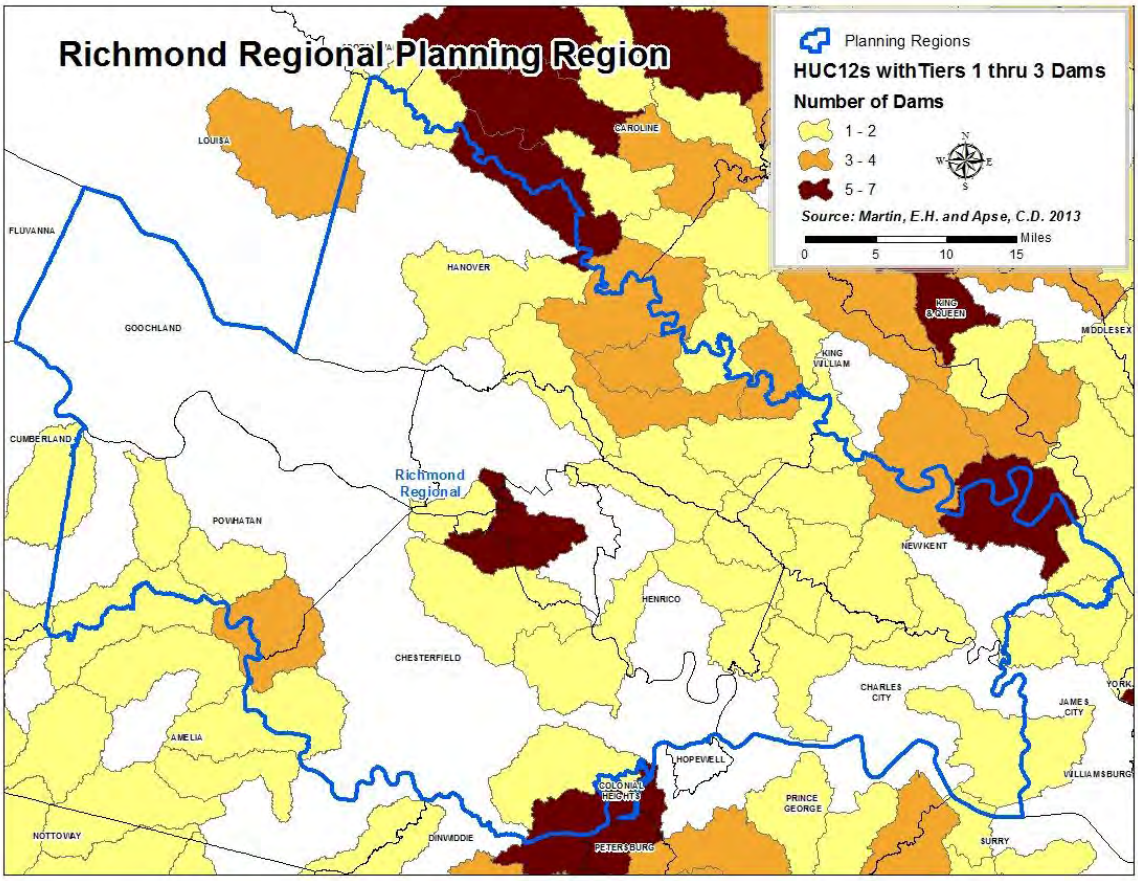

Figure 10. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Richmond Regional Planning Region include monitoring and addressing invasive species impacts and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species also should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Because sea-level rise may be an issue, tree and shrub species that have a broader salinity tolerance should be considered. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these

conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost half of Richmond Regional Planning Region and are important for a broad range of species (Table 5). Forest patches are primarily made up of mixed hardwoods and conifers. Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitats for a variety of priority SGCN species, including the Eastern whip-poor-will, Eastern wood-pewee, Kentucky warbler common rainbow snake, eastern spadefoot toad, and eastern slender glass lizard.

Table 5. Forest Acreage Totals in Richmond Regional Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	652,162.49	46.29%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Richmond Regional Planning Region is fragmentation, which is mainly due to expanding development within the region and resulting roads and infrastructure. In many cases with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

4. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates that deer populations in the Richmond Regional Planning Region have risen dramatically since 1994. Deer populations in Goochland County are estimated to have increased by 6 percent, while populations in Hanover County are estimate to have increased by 112 percent. The draft Deer Management Plan indicates these populations need to be reduced in order to meet a variety of social and ecological goals (DGIF 2015). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. In many cases, deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive species are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in the Richmond Regional Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Bacterial Implementation Plan Development for the James River and Tributaries – City of Richmond* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the James River watershed to help decrease sediment run off as well as provide wildlife habitat (DEQ 2011).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also

hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control (DGIF 2015). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Richmond Regional Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 32,000 acres (2.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than three percent), these habitats are important for priority SGCN, including the tawny crescent and Persius duskywing butterfly.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either

development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015b). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2008). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2008). The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more prone to drought. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2013). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2013). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Installation of Living Shorelines	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of shoreline loss; and • Before/ after comparison of the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within Richmond Regional Planning Region, priority conservation opportunities include:

- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible;
- Improving the quality and quantity of water in creeks and rivers through best management practices and water quality improvement mechanisms;
- Conserving tracts of mature hardwood forests; and
- Maintaining existing open and young forest habitats and pursuing opportunities to restore native open lands and young forests.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN RICHMOND REGIONAL PLANNING REGION

Complete SGCN list for the Richmond Regional Planning Region (SGCN=100). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian	**ST**	II	a	Barking treefrog	*Hyla gratiosa*
Amphibian		III	a	Carpenter frog	*Lithobates virgatipes*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Greater siren	*Siren lacertina*
Amphibian		III	a	Lesser siren	*Siren intermedia intermedia*
Amphibian		IV	a	Little grass frog	*Pseudacris ocularis*
Amphibian	**ST**	II	a	Mabee's salamander	*Ambystoma mabeei*
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*
Amphibian		IV	c	Southern chorus frog	*Pseudacris nigrita*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Brant	*Branta bernicla*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Bicknell's thrush	*Catharus bicknelli*
Bird	**SE**	I	a	Black rail	*Laterallus jamaicensis*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		III	a	Black-crowned night-heron	*Nycticorax nycticorax*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*

Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		IV	a	Marbled godwit	*Limosa fedoa*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird	**ST**	I	a	Peregrine falcon	*Falco peregrinus*
Bird	**FTST**	I	a	Red knot	*Calidris canutus rufus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish	FESE	I	b	Atlantic sturgeon	*Acipenser oxyrinchus*
Fish		I	a	Bridle shiner	*Notropis bifrenatus*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*

FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		I	b	Virginia pigtoe	*Lexingtonia subplana*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FS**	II	c	Rare skipper	*Problema bulenta*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal		IV	c	Cotton mouse	*Peromyscus gossypinus gossypinus*
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Mammal		III	b	Southeastern fox squirrel	*Sciurus niger niger*
Other Terrestrial Invertebrate		IV	c	Fine-ribbed striate	*Striatura milium*
Reptile	**SE**	II	a	Canebrake rattlesnake	*Crotalus horridus (canebrake)*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		III	a	Glossy crayfish snake	*Regina rigida rigida*
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*
Reptile	**CC**	II	a	Northern diamondback terrapin	*Malaclemys terrapin terrapin*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

22. ROANOKE VALLEY-ALLEGHANY PLANNING REGION LOCAL ACTION PLAN SUMMARY

WILDLIFE ACTION PLAN AND LOCAL SUMMARIES OVERVIEW

WILDLIFE ACTION PLAN

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG) that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Action Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN in the Plan are listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

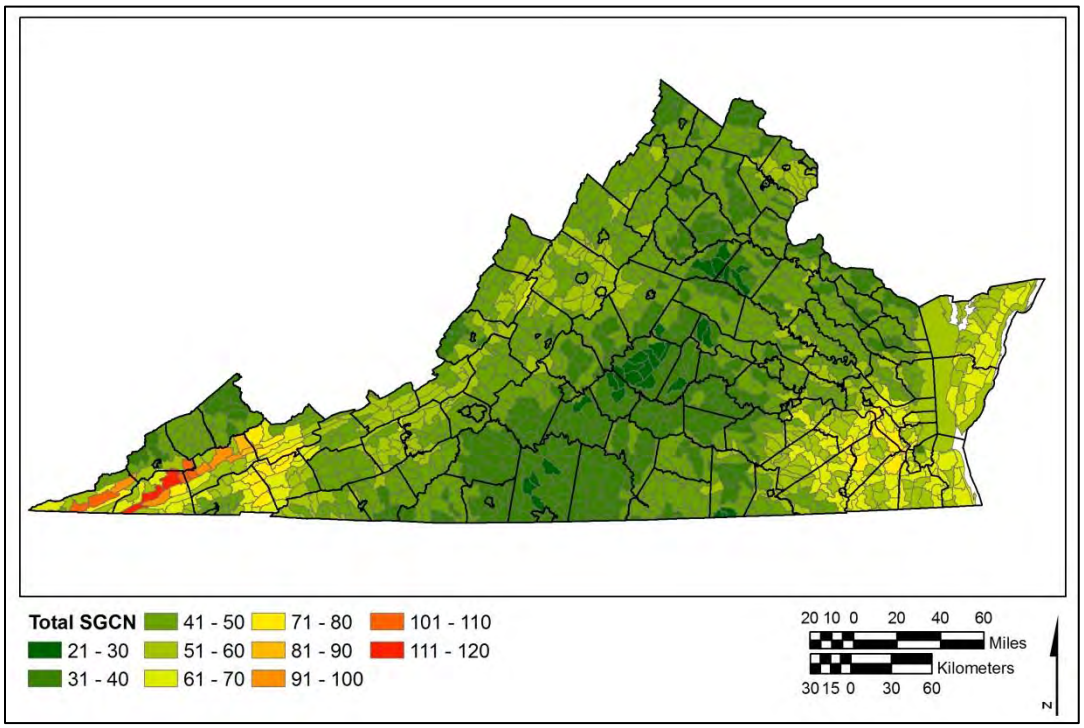

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

ROANOKE VALLEY-ALLEGHANY REGIONAL COMMISSION SUMMARY OVERVIEW

The Roanoke Valley-Alleghany Planning Region consists of 1,504,024 acres (2,350 square miles) and includes the counties of Alleghany, Botetourt, Craig, and Roanoke; cities of Covington, Roanoke, and Salem; and towns of Clifton Forge, Rocky Mount, and Vinton. The human population in this planning region is estimated to be over 335,000 people (U.S. Census Bureau 2015). The planning region is projected to experience population growth by 2030 (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including the nine species that occur only within this region and nowhere else in the world. They include the Alleghany County cave amphipod, New Castle murder hole amphipod, Nelson's cave beetle, talus coil, Venetia millipede, a cave springtail. The planning region also includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

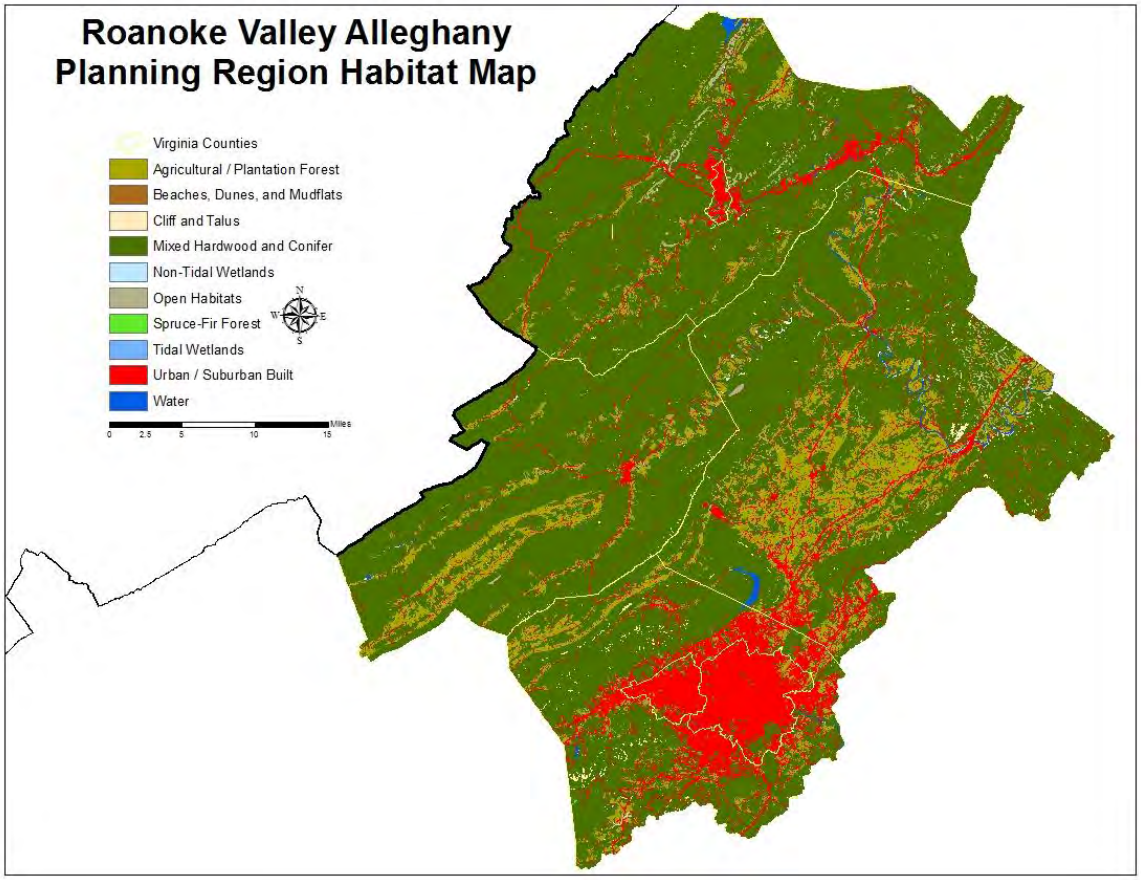

Figure 2. Roanoke Valley- Alleghany Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 111 are believed to either occur, or have recently occurred, within the Roanoke Valley-Alleghany Planning Region (Appendix A). Of these 111 species, ***67 SGCN are dependent upon habitats provided within the Roanoke Valley-Alleghany Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 66 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also

included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	6
Ib	3
Ic	5
IIa	1
IIb	3
IIc	17
IIIa	7
IIIb	1
IIIc	3
IVa	12
IVb	6
IVc	3

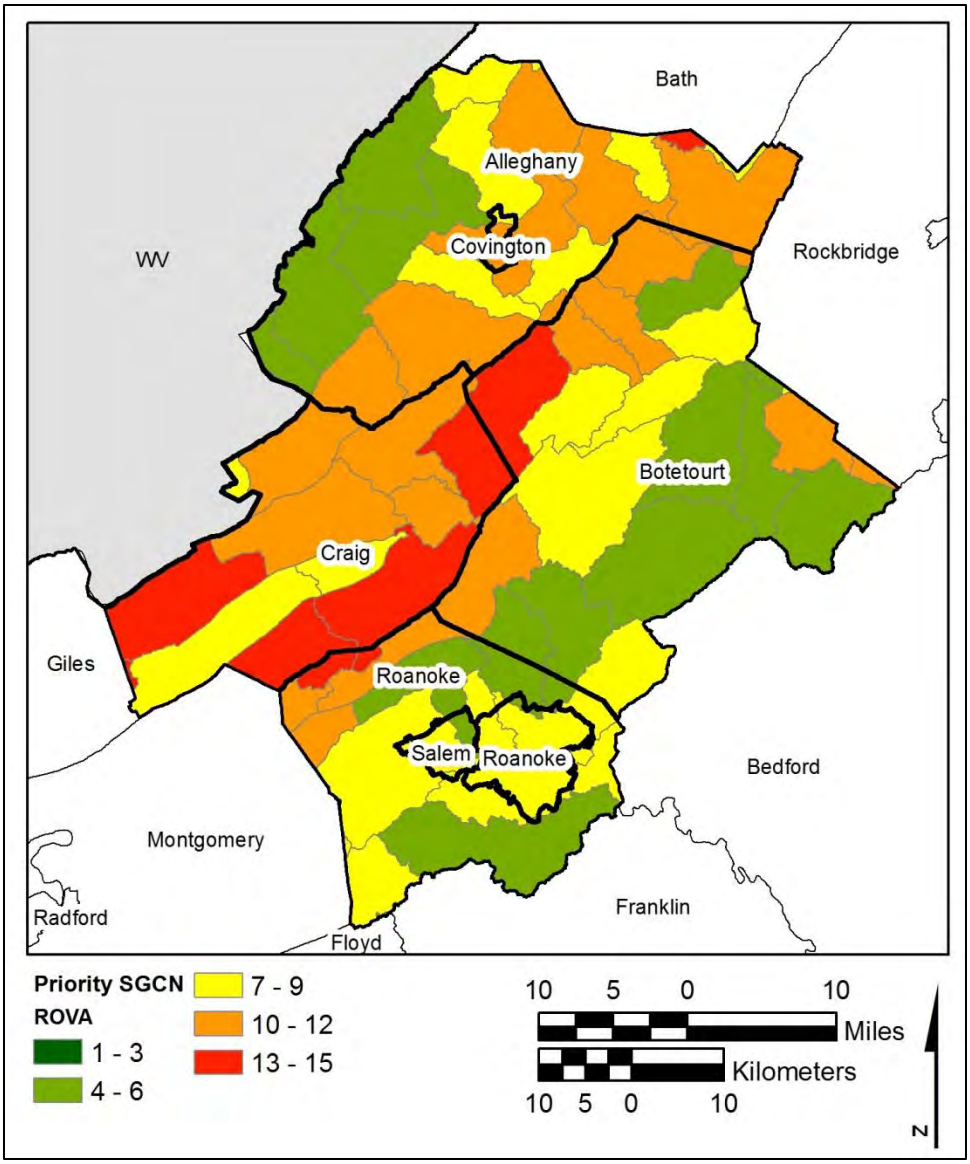

Figure 3. Priority SGCN Density in the Roanoke Valley-Alleghany Planning Region (HUC12).

Table 2. Priority Species of Greatest Conservation Need Distribution in the Roanoke Valley-Alleghany Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*	West of Shenandoah River - high elevation hardwood forests
Amphibian	**FS**	I	c	Peaks of Otter salamander	*Plethodon hubrichti*	Site specific - utilizing various forest, rhododendron thickets, and forested talus slopes with deep moist soils
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes

Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats
Bird		III	a	Eastern whip-poor-will	*Caprimulgus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*	Open shrubby habitat (ex. old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps.
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River
Bird		III	a	Ruffed grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.

Crustacean	**FS**	II	c	Alleghany County cave amphipod	*Stygobromus hoffmani*	Caves with clean abundant water flowing through the system
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*	Clean flowing streams with rocky substrates
Crustacean	**FS**	II	c	Bath County cave amphipod	*Stygobromus mundus*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	I	a	Ephemeral cave amphipod	*Stygobromus ephemerus*	Cave/ Karst
Crustacean	**FS**	II	c	Henrot's Cave isopod	*Caecidotea henroti*	Cave/ Karst
Crustacean	**FS**	II	c	Montgomery County cave amphipod	*Stygobromus fergusoni*	Cave/ Karst
Crustacean	**FS**	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*	Caves with clean abundant water flowing through the system
Crustacean	**FS**	II	c	New Castle Murder Hole amphipod	*Stygobromus interitus*	Caves with clean abundant water flowing through the system
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*	Moderate gradient streams with unsilted rubble, boulder, or rock outcrop substrate
Fish		IV	c	Blackside darter	*Percina maculata*	Clean streams and rivers with moderate gradient and various substrates
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*	Moderate to strong flows with unsilted substrates
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*	Clear medium sized streams with moderate current
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*	Clean swift waters with stable grave or sand/ gravel substrate
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*	Clear flowing water with sand, gravel, or cobble substrates
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*	Clean streams with stable banks and sand or gravel substrates
Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus gracilis*	Caves with clean abundant water flowing through the system
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*	Large rivers with rocks and moderate current
Insect	**FS**	II	c	Maureen's shale stream beetle	*Hydraena maureenae*	The known habitat is a shale bottom Appalachian stream. This species prefers the margins of clear mountain streams, adults sometimes occur on submerged vegetation, but occur mostly among sand grains.
Insect	**FS**	II	c	Nelson's cave beetle	*Pseudanophthalmus nelsoni*	Caves with clean abundant water flowing through the system

Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*	Pine barrens/ oak savanna and other open sunny habitats
Insect	**FS**	II	c	Spotted cave beetle	*Pseudanophthalmus punctatus*	Cave/ Karst
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*	Dry habitats including clearings, open woods and roadsides containing wavy-leaved asters
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*	Blue Ridge to the west - cliffs dry rocky slopes, talus, and exposed ridges
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred, though. Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.
Mammal	**FESE**	I	b	Indiana bat	*Myotis sodalis*	West of Shenandoah River - winter site specific caves, summer forested areas containing trees with scaly or shaggy bark as well as dead trees
Mammal	**SE**	II	b	Southern water shrew	*Sorex palustris*	High elevation riparian areas in Bath and Highland counties
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius anophthalmus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia sublevis*	Cave/ Karst
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius holsingeri*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate	**FSST**	I	c	Ellett Valley Pseudotremia millipede	*Pseudotremia cavernarum*	Cave/ Karst
Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*	Known from four locations and occupies leaf litter at the base of limestone/ shale outcropings
Other Terrestrial Invertebrate	**FS**	II	c	Talus coil	*Helicodiscus triodus*	No habitats have been identified for this species
Other Terrestrial Invertebrate	**FS**	II	c	Venetia millipede	*Conotyla venetia*	No habitats have been identified for this species
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*	Dry open slopes with cover and soils suitable for burrowing
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*	Moist meadows or grassy areas at the edges of bogs or small streams

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Roanoke Valley-Alleghany Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national forests to state wildlife management areas and forests to conservation easements. Significant conservation assets, in terms of size, include:

- George Washington and Jefferson National Forests,
- Blue Ridge Parkway,
- Havens Wildlife Management Area,
- Short Hills Wildlife Management Area,
- Niday Place State Forest
- Johnsons Creek State Natural Area Preserve,
- Poor Mountain State Natural Area Preserve, and
- Carvins Cove Reservoir.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

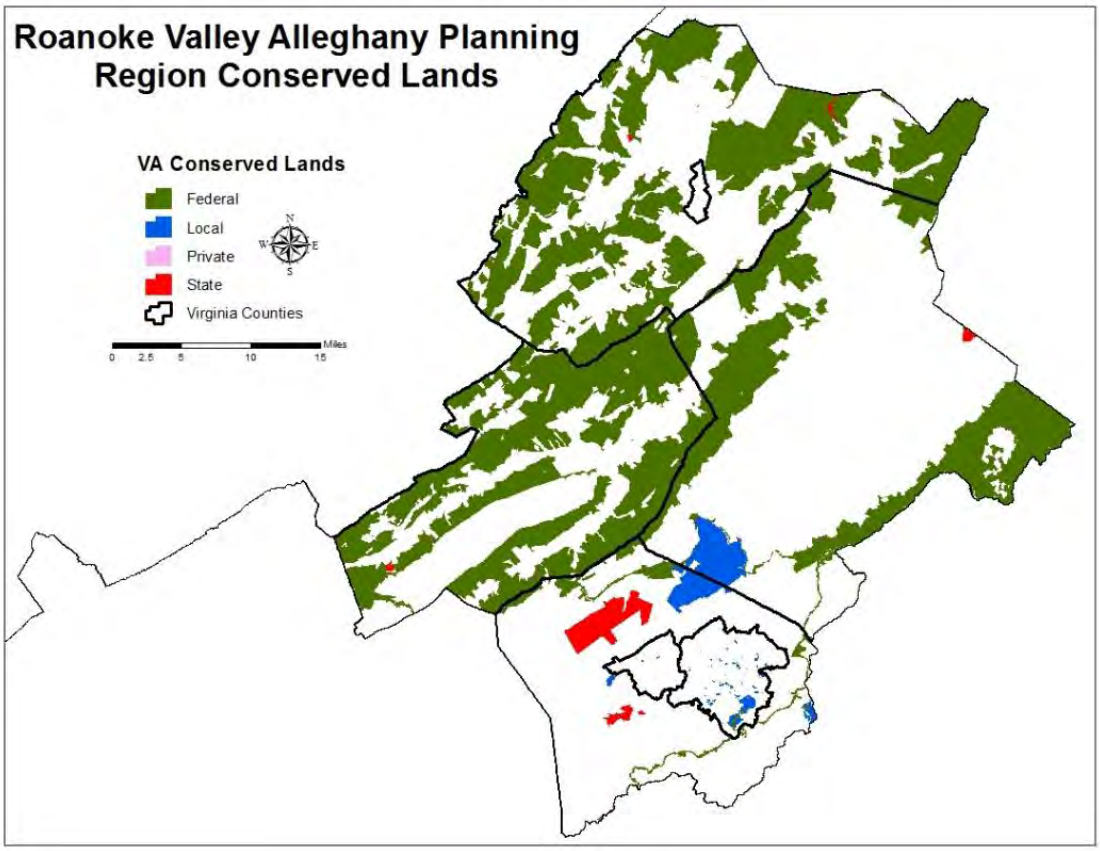

Figure 4. Conservation Lands in the Roanoke Valley-Alleghany Planning Region (DCR, Natural Heritage 2014).

These properties are the backbone of wildlife conservation efforts on within the Roanoke Valley-Alleghany Planning Region. A significant portion of the planning region is conserved; however, it may be beneficial for many SGCN and habitats within the region to work towards putting additional lands under protection. There may be concern over the economic and social impacts of putting more lands into conservation, but many of these areas provide recreation and ecotourism benefits (DCR 2013a; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Roanoke Valley-Alleghany Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SCGN in the Roanoke Valley-Alleghany Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Temperature changes are likely to be even greater in the Appalachians than at lower elevations due to a range of factors such as snow albedo, water vapor changes and latent heat release, aerosols, among others (Staudinger et al. 2015). Projections also indicate a likely increase in summer high temperatures and longer growing seasons (Staudinger et al. 2015). These changes could affect depth of snow pack and earlier snow melt.

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the Roanoke Valley-Alleghany Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Roanoke Valley-Alleghany Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Roanoke Valley-Alleghany Planning Region.

Conservation Strategy	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; 6) Better control of fecal matter and sewage.	Increasing industrial/residential water consumption, sedimentation and pollutants, protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish riparian buffers; 2) Establish waste storage facilities for dairy and horse operations; 3) Improve pasture and loafing lot management to reduce tainted runoff; 4) Exclude livestock from streams; 5) Protect sinkholes; 6) Enhance manure incorporation into croplands; 7) Establish vegetative buffers in residential areas; 8) Repair failing septic systems and eliminating "straight pipes;" 9) Establish a pet waste program to reduce bacterial inputs from pets; 10) Continue to identify impaired waters within the planning region; 11) Restore aquatic connections; 12) Monitor and address invasive species impacts; and 13) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities, contribute to clean water supply	Looney Creek
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Roanoke Valley-Alleghany Planning Region contains cave/ karst habitats that are relatively unique in Virginia. These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR 2015). Because cave entrances and karst habitats are sensitive systems, exact locations of karst habitats are not provided in this Action Plan; however, general areas that contain karst features are provided in Figure 5. Karst systems provide important habitats for many SGCN, including the Eastern small-footed myotis, Alleghany County cave amphipod, New Castle murder hole, amphipod Nelson's cave beetle, and a wide variety other important species. Others species such as the Indiana bat depend on karst habitat and are endangered throughout their range. Caves in this planning region provide crucial winter habitat for some bat species.

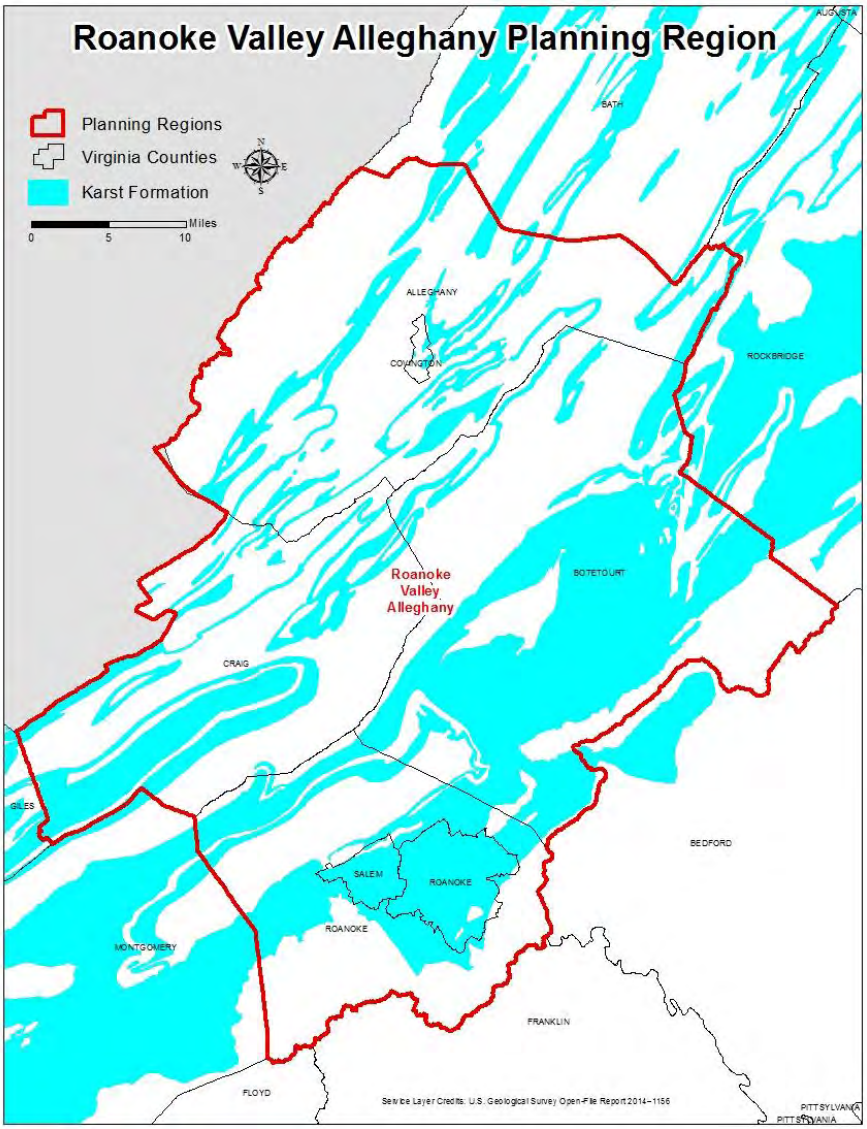

Figure 5. Karst Areas in the Roanoke Valley-Alleghany Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems are affected by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems also often occurs when sinkholes are used as disposal sites as well as through development and resulting pollutant-laden runoff (DCR 2008).

2. Predators: Predators such as raccoons, cats, and skunks can opportunistically prey on sensitive karst species; diseases such as white nose syndrome can dramatically reduce bat populations; and human use in caves can negatively affect these habitats.

3. Altered Hydrology: Development, which likely plays a role in degraded water quality in the areas where karst occurs, can result in altered hydrology which can affect water quantity and flows. The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography.

4. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing protected areas around these karst systems

may also be valuable. Additionally, local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff. Minimizing impervious surface (see following section) will be even more important under climate change as with increased storm intensity will result in more stormwater runoff.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Roanoke Valley-Alleghany Planning Region include cold and warm water rivers, streams, and creeks. Most of the planning region is within the Roanoke River and James River watersheds. Approximately 6,330 acres (0.6 percent) of the planning region is considered aquatic (Anderson et al. 2013; DGIF 2015). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many mussels, snails, crayfish, and fish species, such as the Kosztarab's common stonefly, roughhead shiner, orangefin madtom, James spinymussel, brook trout, bigeye jumprock, Roanoke bass, and Roanoke logperch.

Threats

Aquatic and riparian habitats within the Roanoke Valley-Alleghany Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the planning region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region’s creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005).Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface

water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although areas in the Roanoke Valley-Alleghany Planning Region have a high percentage of impervious surface cover, the majority of the planning region has a low percentage of impervious surface cover (Figure 6).

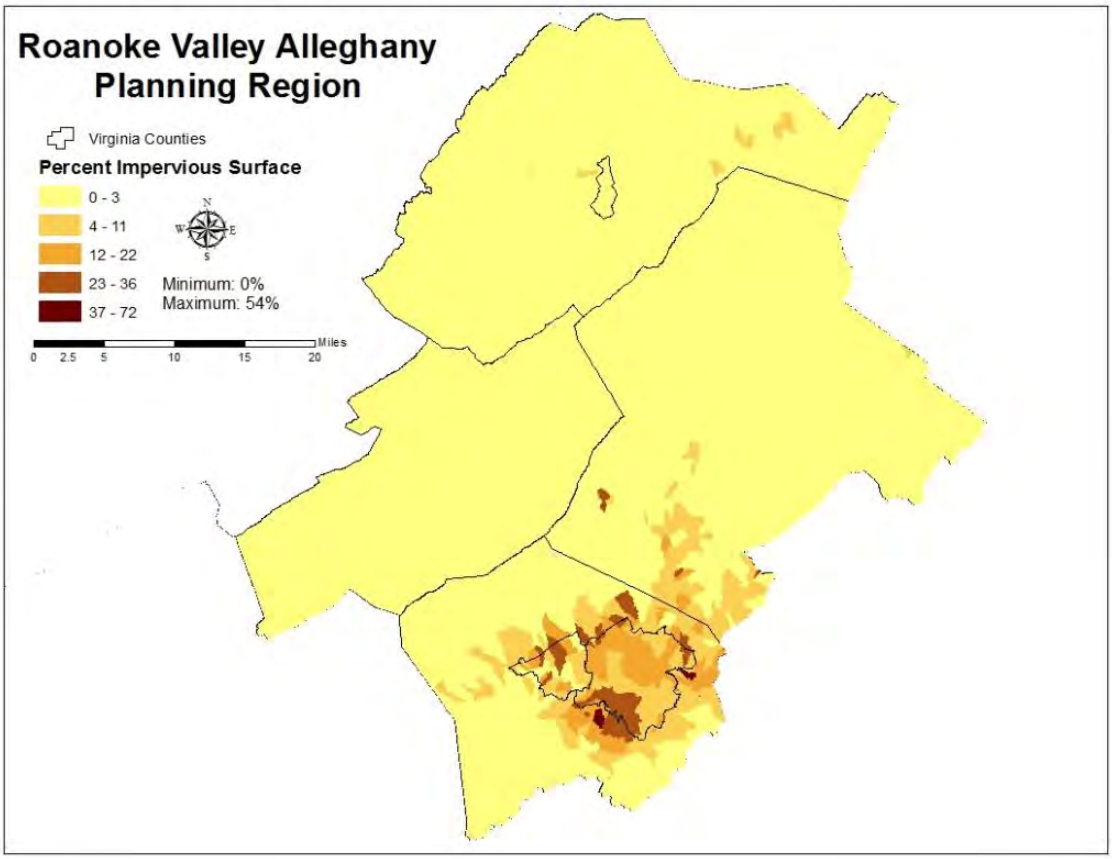

Figure 6. Impervious Surface Cover in Roanoke Valley-Alleghany Planning Region (SARP 2014).

3. Catastrophic Spills: Catastrophic spills from industrial sites or road crossings can result in extensive loss of species and habitat in a short time period.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

6. Stream pH: Fish species are sensitive to water pH, and pH can play a role in species richness. Waters flowing through the non-karst areas in this planning region have experienced acid deposition over decades, making the waters more acidic and potentially harming or extirpating aquatic species such as brook trout (Webb 2014). Streams may also become more alkaline due to mine runoff and underground mine pumping, which can also alter stream habitat.

7. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Looney Creek (MapTech 2007) (Figure 7).

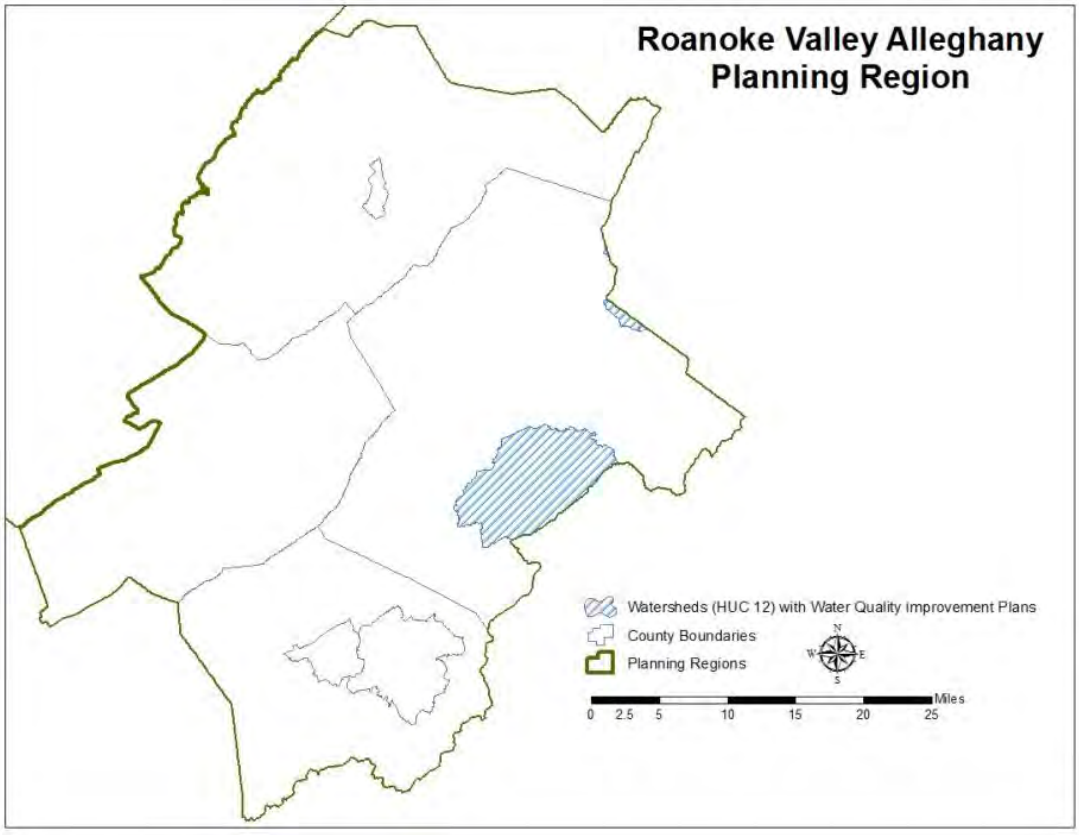

Figure 7. Watersheds with Water Quality Improvement Plans.

This watershed is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing riparian buffers;
- Establishing waste storage facilities for dairy and horse operations;
- Improving pasture and loafing lot management to reduce tainted runoff;
- Excluding livestock from streams;
- Protecting sinkholes;
- Enhancing manure incorporation into croplands;
- Establishing vegetative buffers in residential areas;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams; and
- Establishing a pet waste program to reduce bacterial inputs from pets.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 8).

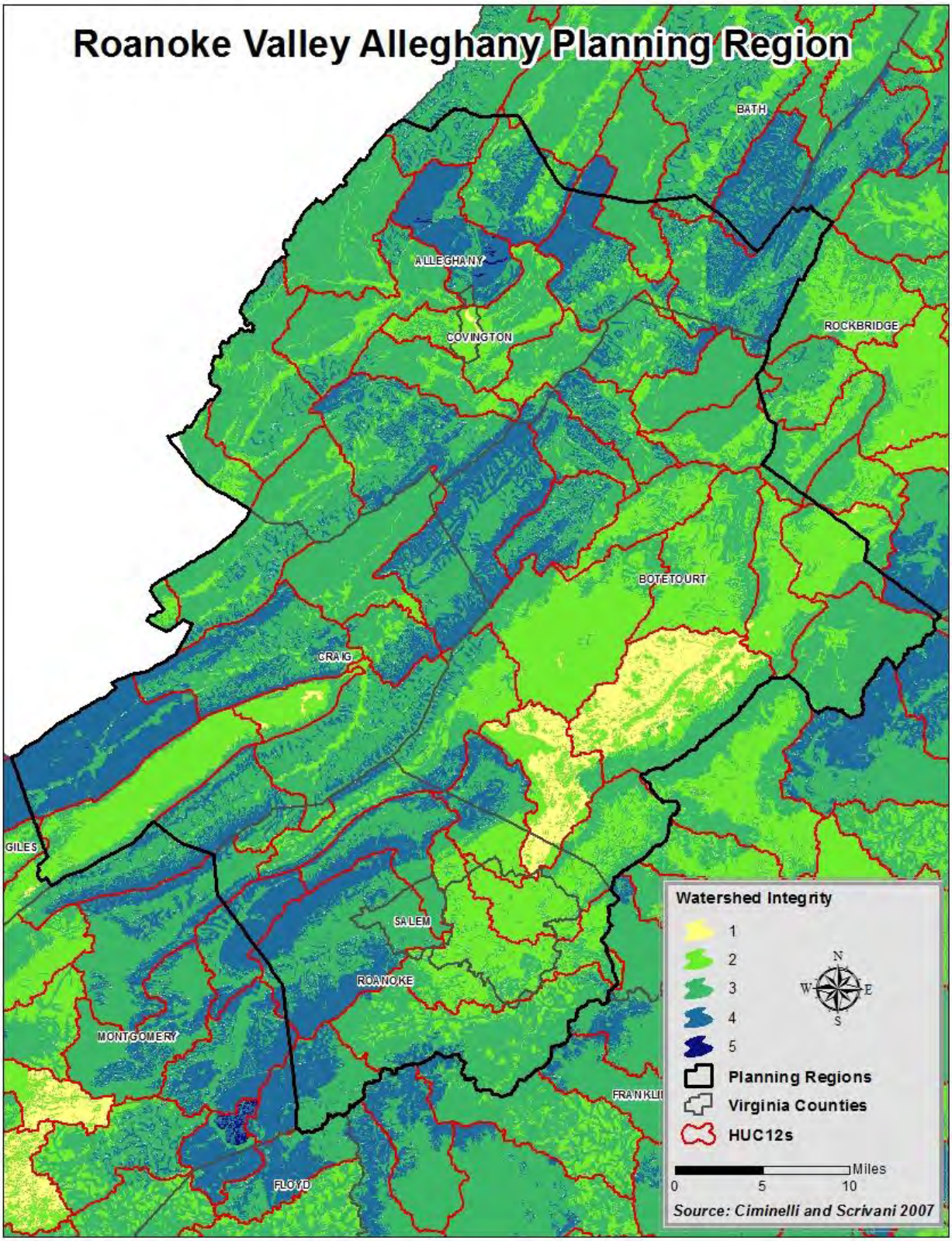

Figure 8. Watershed Integrity Model for Roanoke Valley-Alleghany Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers;
- Reducing impervious surface by replacing with more porous materials or vegetation; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Roanoke Valley-Alleghany Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). The Natural Resources Conservation Service (NRCS) provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Additional actions to improve aquatic systems in the Roanoke Valley-Alleghany Planning Region include: restoring aquatic connections (i.e., removing culverts, dams, etc.), monitoring and addressing invasive species impacts, and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up approximately 75 percent of the Roanoke Valley-Alleghany Planning Region and are important for a broad range of species (Table 4). There are a few acres of spruce fir forest remaining. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. These forests help protect water resources within the region and provide habitat for species such as the cerulean warbler, ruffed grouse, Eastern whip-poor-will, Northern saw-whet owl, Peaks of Otter salamander, Jefferson salamander, and Appalachian cottontail, among other species.

Table 4. Forest Acreage Totals in the Roanoke Valley-Alleghany Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent Planning Region
Spruce Fir	40.48	0.00%
Mixed Hardwood and Conifer	798,562.08	76.23%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Roanoke Valley-Alleghany Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Mining and other extractive uses could also degrade habitat and affect species composition and water quality.

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the hemlock wooly adelgid (DOF 2014).

3. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

4. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of the spruce fir forests in the planning region are already under some form of conservation) in the Roanoke Valley-Alleghany Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Reed Creek Watershed TMDL Implementation Plan Technical Report* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Reed Creek watershed to help decrease sediment run off as well as provide wildlife habitat (DEQ 2012). Similar actions are recommended for the Middle Fork Holston River and Wolf Creek watersheds (DCR 2013).

Several agencies, including DGIF, NRCS, DOF, and the U.S. Forest Service advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Roanoke Valley-Alleghany Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 9,910 acres (0.95 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region, these habitats are important for priority SGCN, including the golden-winged warbler, loggerhead shrike, Appalachian grizzled skipper and tawny crescent.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., prescribed burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest (WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2006). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2006). NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Many glade habitats occur within this planning region on both public and private lands. Conserving these habitats will require with willing landowners or agency managers to control invasive species, maintain the vegetative communities with fire, and managing the recreations uses of these areas to prevent the unique plant communities from being trampled.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al, 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into

Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Roanoke Valley-Alleghany Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Protecting the quantity and quality of water.
- Maintain and conserve patches of spruce fir and mixed hardwood conifer forests.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN ROANOKE VALLEY-ALLEGHANY PLANNING REGION

Complete SGCN list for the Roanoke Valley-Alleghany Planning Region (SGCN=110). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in in alphabetical order by taxa.

Taxa	Conservation	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	c	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian	**FS**	I	c	Peaks of Otter salamander	*Plethodon hubrichti*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		I	a	Golden-winged warbler	*Vermivora chrysoptera*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*

Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	II	c	Alleghany County cave amphipod	*Stygobromus hoffmani*
Crustacean		IV	c	Allegheny crayfish	*Orconectes obscurus*
Crustacean	**FS**	II	c	Bath County cave amphipod	*Stygobromus mundus*
Crustacean	**FS**	I	a	Ephemeral cave amphipod	*Stygobromus ephemerus*
Crustacean	**FS**	II	c	Henrot's Cave isopod	*Caecidotea henroti*
Crustacean	**FS**	II	c	Montgomery County cave amphipod	*Stygobromus fergusoni*
Crustacean	**FS**	III	c	Natural Bridge cave isopod	*Caecidotea bowmani*
Crustacean	**FS**	II	c	New Castle Murder Hole amphipod	*Stygobromus interitus*
Fish		III	a	American eel	*Anguilla rostrata*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish		IV	c	Blackside darter	*Percina maculata*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**CC**	I	b	Candy darter	*Etheostoma osburni*
Fish		IV	c	Logperch	*Percina caprodes*
Fish		IV	c	New River shiner	*Notropis scabriceps*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*

FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FS**	II	c	A cave beetle	*Pseudanophthalmus gracilis*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect		II	c	Green-faced clubtail	*Gomphus viridifrons*
Insect	**FS**	II	c	Maureen's shale stream beetle	*Hydraena maureenae*
Insect	**FS**	II	c	Nelson's cave beetle	*Pseudanophthalmus nelsoni*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Insect	**FS**	II	c	Spotted cave beetle	*Pseudanophthalmus punctatus*
Insect	**FS**	II	c	Tawny crescent	*Phyciodes batesii batesii*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal	**FESE**	II	a	Gray bat	*Myotis grisescens*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**SE**	II	b	Southern water shrew	*Sorex palustris*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Terrestrial Invertebrate	**FS**	II	c	A cave pseudoscorpion	*Kleptochthonius anophthalmus*
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Pseudotremia sublevis*
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius holsingeri*
Other Terrestrial Invertebrate	**FSST**	I	c	Ellett Valley Pseudotremia millipede	*Pseudotremia cavernarum*

Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*
Other Terrestrial Invertebrate	**FS**	II	c	Talus coil	*Helicodiscus triodus*
Other Terrestrial Invertebrate	**FS**	II	c	Venetia millipede	*Conotyla venetia*
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	c	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

23. Southside Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Recreation Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

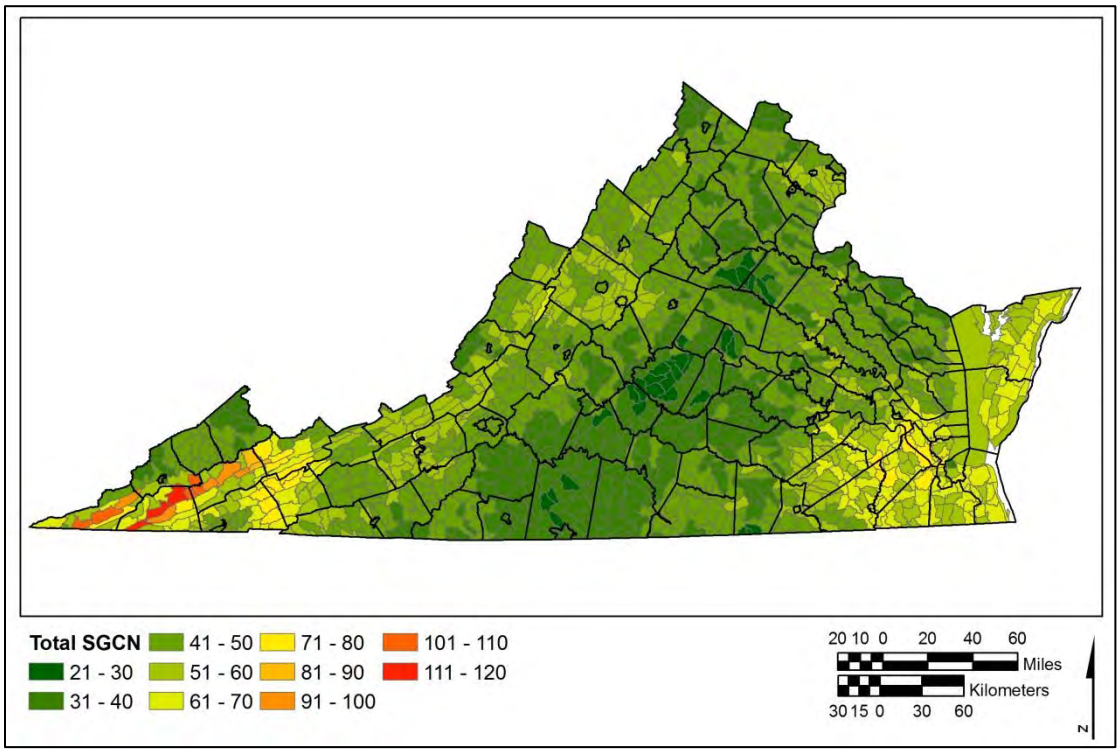

Figure 1. State distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

SOUTHSIDE PLANNING DISTRICT COMMISSION SUMMARY OVERVIEW

The Southside Planning Region consists of 1,330,796 acres (2,079 square miles) and includes the counties of Halifax, Mecklenburg, and Brunswick. The human population in this planning region is estimated to be almost 83,000 people, and it is likely to experience a slight population decrease by 2020 (DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or extractive uses expand. This planning region contains aquatic habitats for a range of SGCN, including whitemouth shiner, Carolina darter, snail bullhead, Tidewater mucket, Atlantic pigtoe, and dwarf waterdog. Its pine savannas provide habitat for the Bachman's sparrow, while its mature mixed hardwood and conifer forests are habitat to the southeastern crowned snake. The planning region also includes a variety of other habitats such as young forests, retired agricultural land, non-tidal wetlands, and freshwater streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

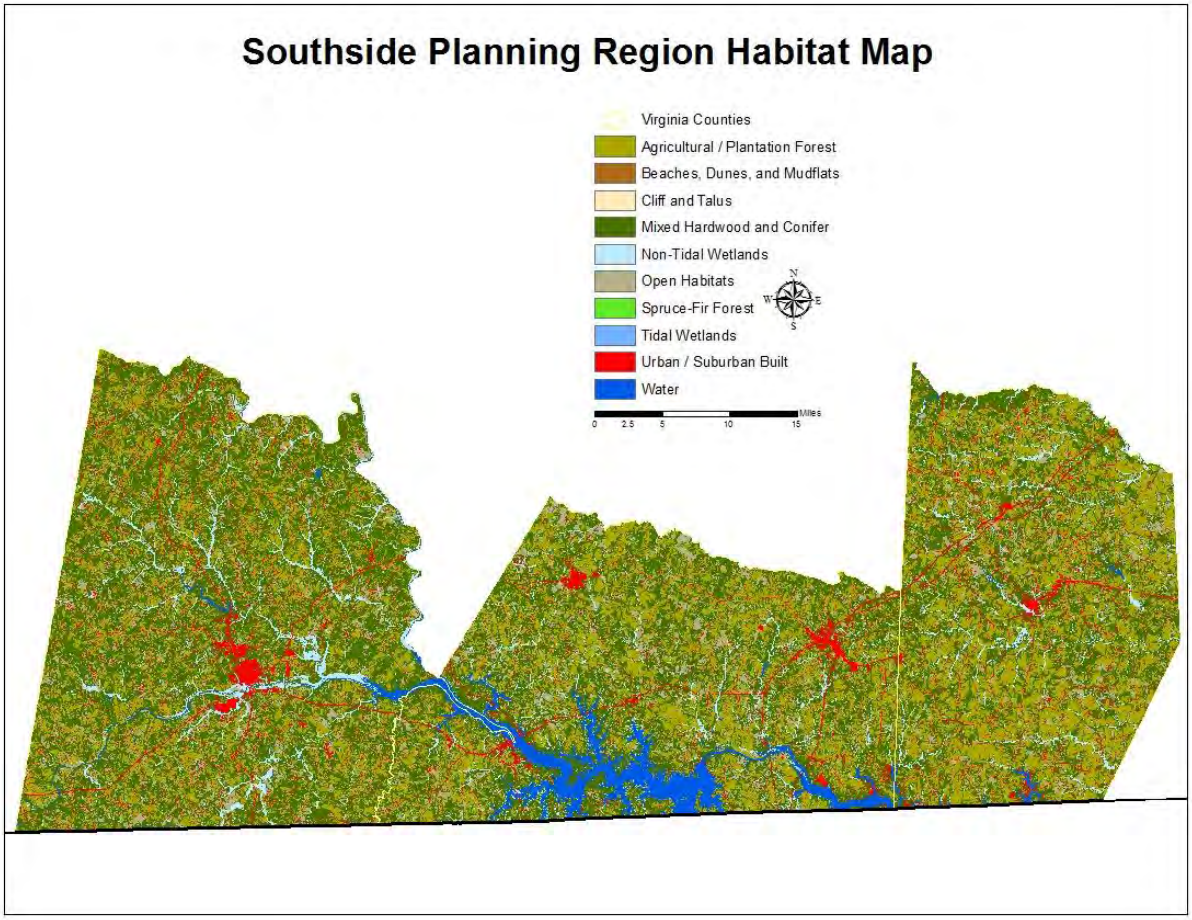

Figure 2. Southside Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 89 are believed to either occur, or have recently occurred, within the Southside Planning Region (Appendix A). Of these 89 species, ***46 SGCN are dependent upon habitats provided within the Southside Planning Region (Table 2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 46 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also

included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	3
IIa	3
IIb	1
IIc	3
IIIa	6
IIIb	1
IIIc	5
IVa	13
IVb	7
IVc	4

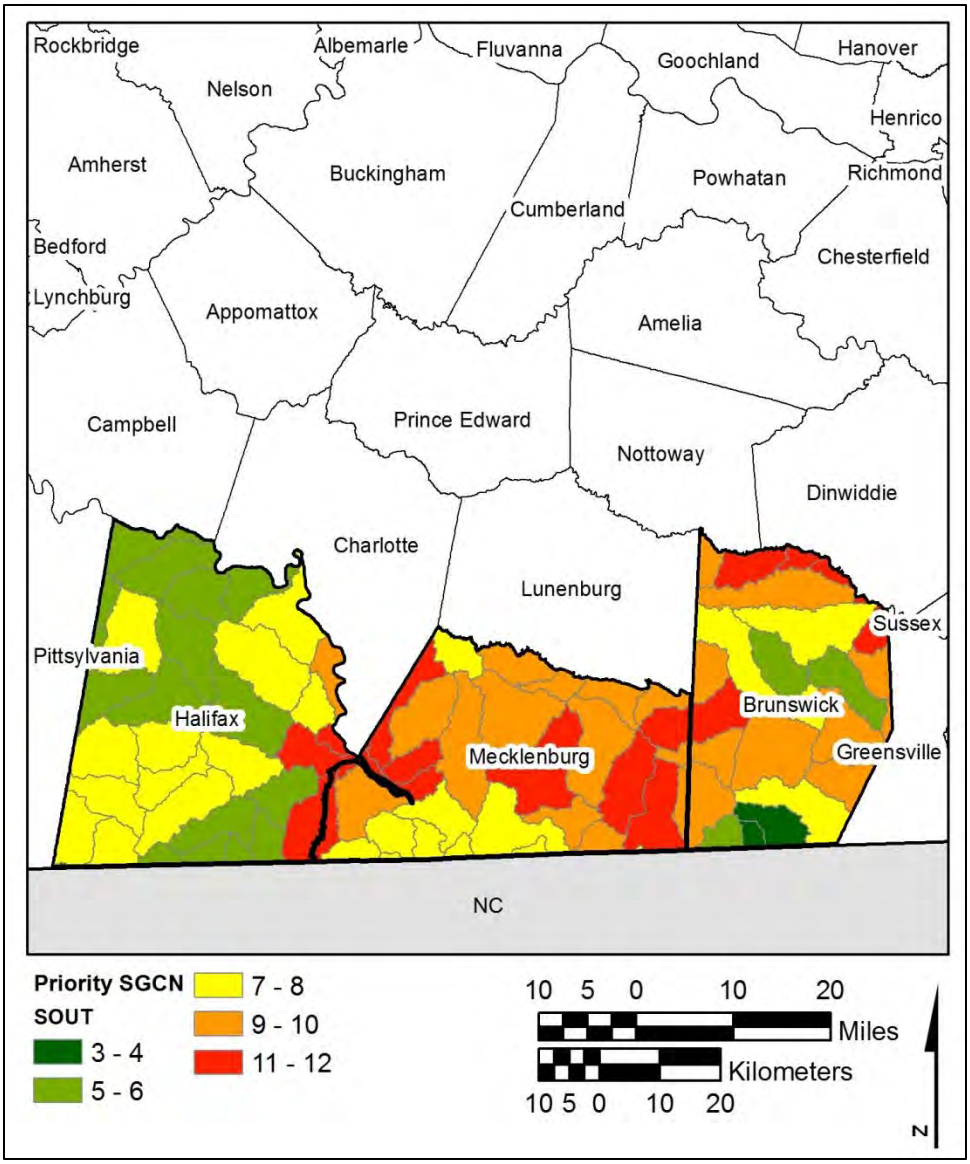

Figure 3. Priority SGCN Density in the Southside Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in Southside Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*	Pine savanna
Bird	**ST**	I	a	Bachman's sparrow	*Peucaea aestivalis*	Pine savanna/ open pine woodlands
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*	Winter resident along beaches and estuaries
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		II	a	Common tern	*Sterna hirundo*	Nests on beaches
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats
Bird		III	a	Eastern whip-poor-will	*Caprimulgus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		III	a	Forster's tern	*Sterna forsteri*	Breeds in marshes with lagoon system
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	*Geothlypis formosa*	Humid deciduous forest, dense second growth, swamps

Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*	Grasslands, orchards and open areas with scattered trees
Bird		III	a	Northern Bobwhite	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*	Sluggish streams and swamps with abundance of dead wood on the bottom
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*	Very slow moving water with sand or gravel substrates flowing through wooded areas or pastures
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*	Warm turbid water in lakes, reservoirs, and pools in low gradient rivers over mud substrate
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*	Moderately acidic creeks, streams, and swamps
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*	Moderate to high gradient streams with rock, gravel, or sand substrates
Fish		III	c	Snail bullhead	*Ameiurus brunneus*	Well flowing streams and rivers with rocky substrates
Fish		IV	c	Speckled killifish	*Fundulus rathbuni*	Slow moving streams and creeks with sandy substrates
Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*	Clear to somewhat turbid creeks, with varying substrates
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*	Alewife obligate - coastal streams and lakes with sand or gravel substrates
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*	Clean swift waters with stable gravel or sand/ gravel substrate
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*	Small streams to rivers with swift flow and sandy substrates
FW Mollusk		III	c	Dwarf waterdog	*Necturus punctatus*	Sluggish streams and blackwater streams with debris
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*	Streams and rivers with high ground water content and good flow
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*	Clean streams with stable banks and sand or gravel substrates
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*	Deeper channels of relatively fast flowing rivers
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*	Ponds, canals, and slow moving sections of rivers, often connected to the ocean and can tolerate a wide variety of substrates
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*	Large streams and rivers with low gradient and sand and gravel substrates

Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Auturus erythropygos*	No habitats have been identified for this species
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	Upland pine habitats
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*	Forest generalist but require soils suitable for digging
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in the Southside Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from conservation easements to state parks and natural area reserves to state wildlife management areas. Significant conservation assets, in terms of size, include:

- Occoneechee State Park,
- Staunton River State Park,
- Dick Cross Wildlife Management Area,
- Difficult Creek State Natural Area Preserve,
- Ward Burton Wildlife Foundation Preserve, and
- John H. Kerr Reservoir.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

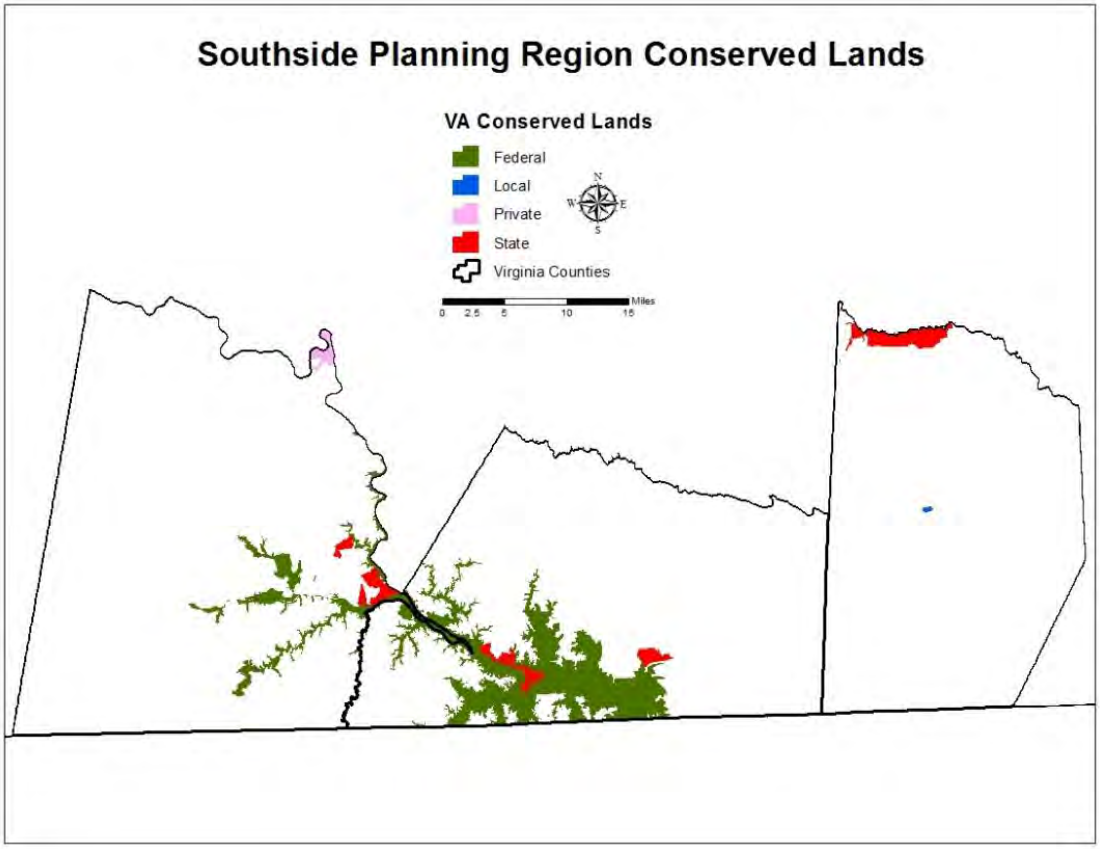

Figure 4. Conservation Lands in the Southside Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts within Southside Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in Southside Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SGCN in the Southside Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions to Wildlife and Habitats in the Southside Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Southside Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary Conservation Strategies and Actions for the Southside Planning Region.

Conservation Strategies	Conservation Actions	Threats Addressed	Economic/ Human Benefits	Priority Areas
Enhance, maintain, and restore aquatic and riparian habitats	1) Exclude livestock from streams;2) Establish riparian buffers in agricultural areas; 3) Reforest erodible pasture lands and establishing permanent vegetative cover on critical areas; 4) Improve pasture and loafing lot management to reduce tainted runoff; 5) Create runoff impoundments or other structures to slow the flow of runoff into streams; 6) Enhance manure incorporation into croplands;7) Establish vegetative buffers in residential areas; 8) Repair failing septic systems and eliminating "straight pipes;" 9) Establish a pet waste program to reduce bacterial inputs from pets; 10) Continue to identify impaired waters within the planning region; 11) Restore aquatic connections; 12) Monitor and address invasive species impacts; and 13) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Banister River, Polecat Creek, Sandy Creek, Three Creek
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers	Areas supporting SGCN that are not already protected

Enhance, Maintain, and Restore Aquatic and Aquatic Habitats

Aquatic systems in the Southside Planning Region include warm water, freshwater rivers, streams, and creeks. Most of the planning region is in the Roanoke River watershed. Approximately 48,300 acres (3.6 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include the whitemouth shiner, Carolina darter, snail bullhead, speckled killifish, Roanoke slabshell, freshwater drum, and Chowanoke, among others.

Threats

Aquatic and riparian habitats within the Southside Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Southside Planning Region. Fertilizers, eroded sediment, and human and animal waste flow into the region's tidal creeks from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop the flow of these materials and prevent them from running into the creek or stream (ACJV). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Most of the Southside Planning Region has a low percentage of impervious surfaces (Figure 5).

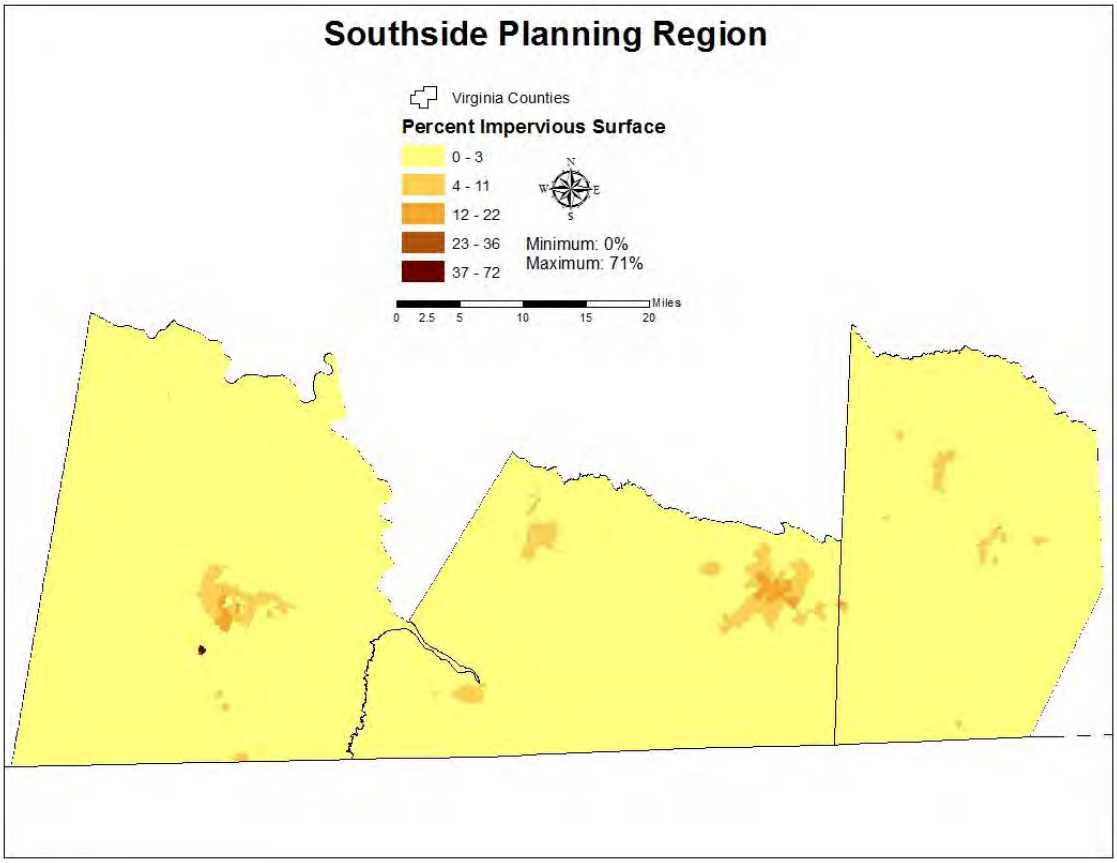

Figure 5. Impervious Surface Cover in Southside Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Southside Planning Region include invasive species that consume native species or consume aquatic vegetation, thereby altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Banister River, Polecat Creek, and Sandy Creek (Blue Ridge Environmental Solutions, 2012), and Three Creek (Working Group 2013) (Figure 6).

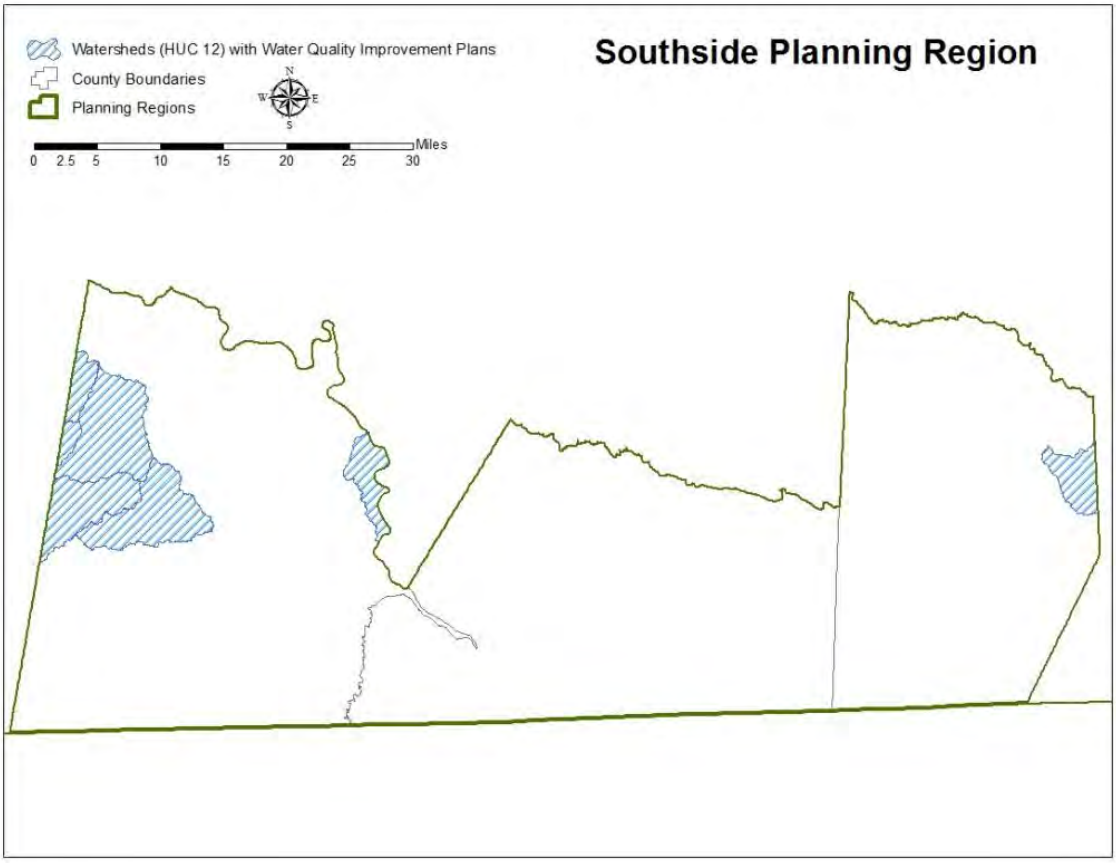

Figure 6. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Excluding livestock from streams;
- Establishing riparian buffers in agricultural areas;
- Reforesting erodible pasture lands and establishing permanent vegetative cover on critical areas;
- Improving pasture and loafing lot management to reduce tainted runoff;
- Creating runoff impoundments or other structures to slow the flow of runoff into streams;
- Enhancing manure incorporation into croplands;
- Establishing vegetative buffers in residential areas;
- Repairing failing septic systems and eliminating “straight pipes” depositing human waste into streams; and

- Establishing a pet waste program to reduce bacterial inputs from pets.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 7).

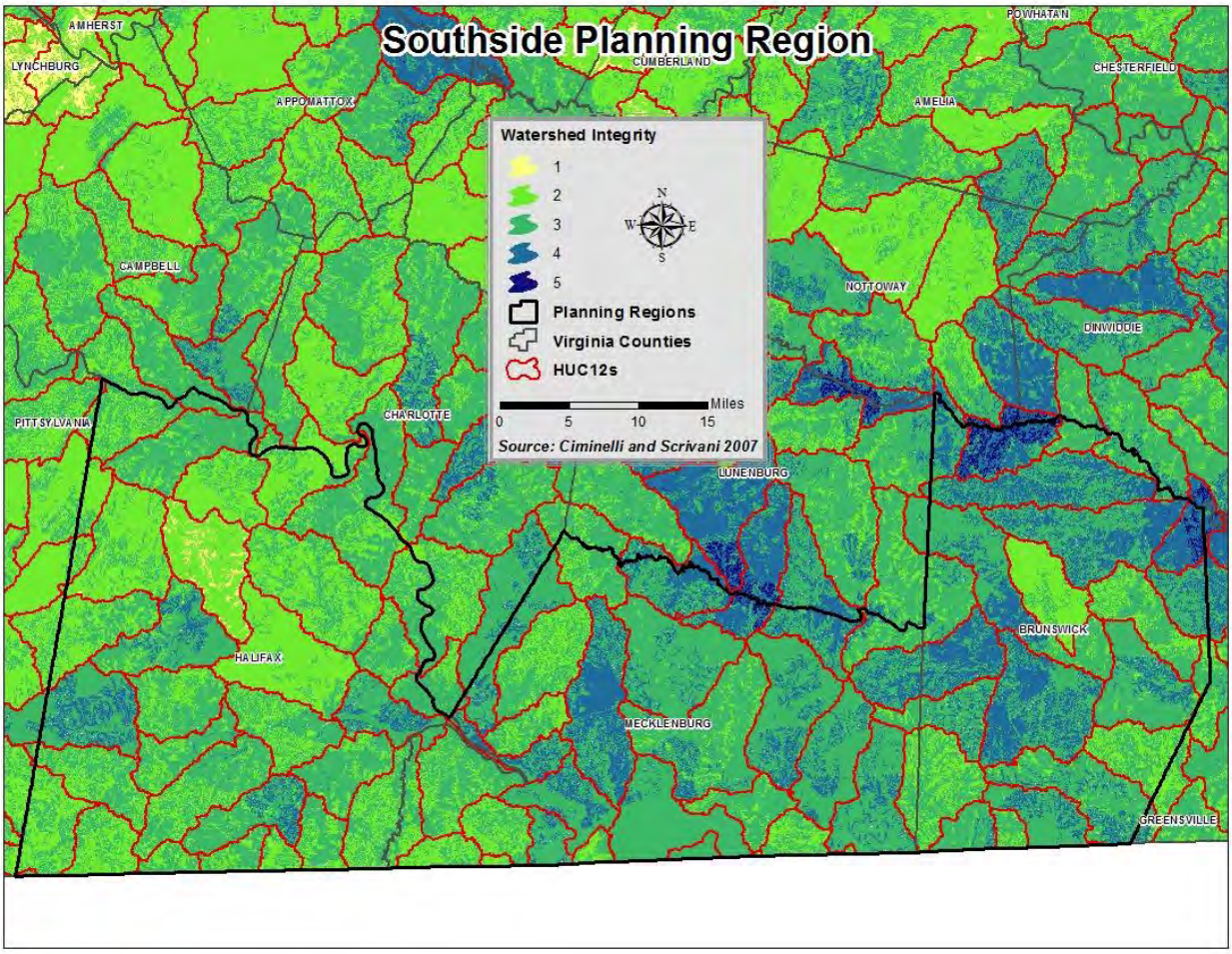

Figure 7. Watershed Integrity Model for Southside Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Many agencies help landowners in the Southside Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established best management practices (BMPs) for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). The Natural Resources Conservation Service (NRCS) provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 8) (Martin and Apse 2013).

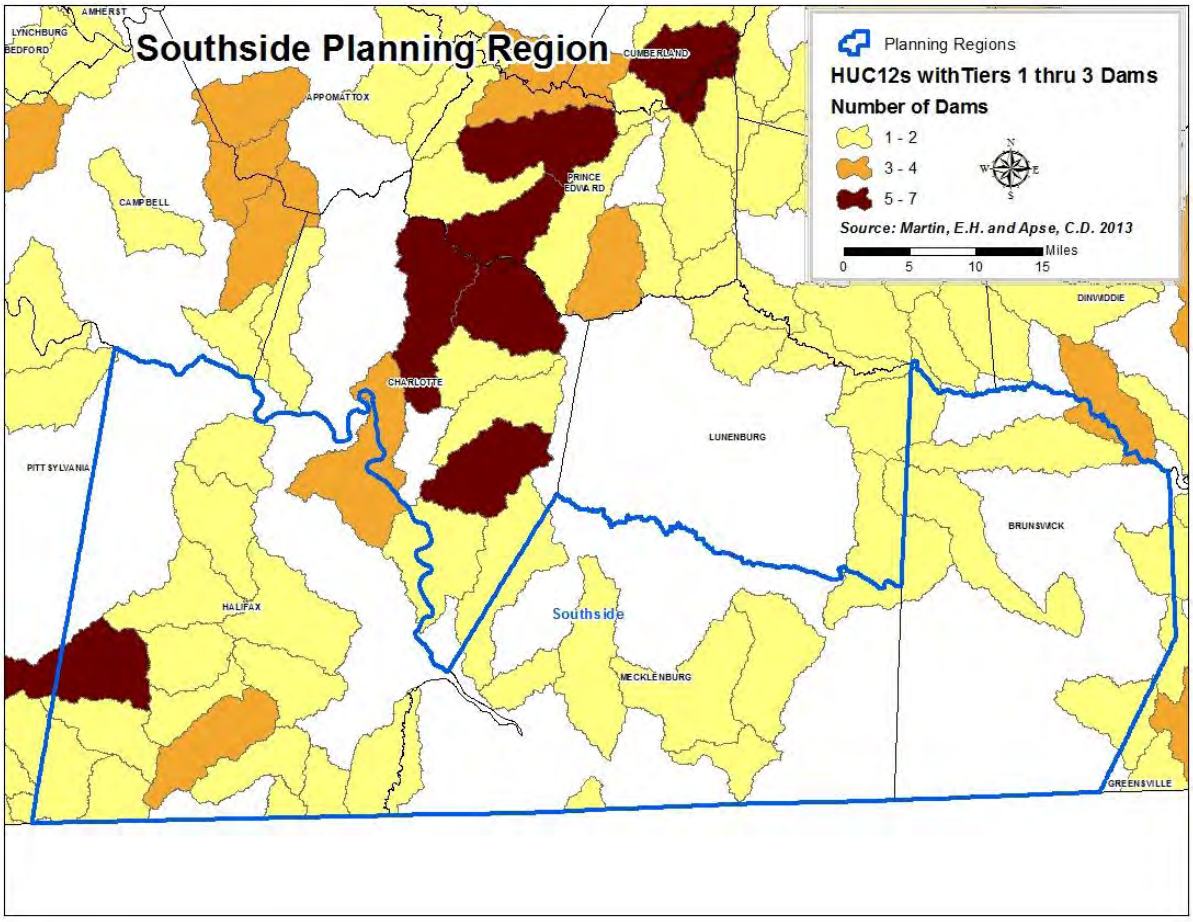

Figure 8. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Southside Planning Region include monitoring and addressing invasive species impacts and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of storm water runoff. Improving storm water control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost half of Southside Planning Region and are important for a broad range of species (Table 4). Within this forest type the majority of the trees are mature. Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the Eastern whip-poor-will, wood thrush, Kentucky warbler, southeastern crowned snake, Eastern slender glass lizard, and a variety of other species.

Table 4. Forest Acreage Totals in Southside Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	602,026.98	45.23%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to mixed hardwood and conifer forests within Southside Planning Region is fragmentation, mainly due to expanding development and resulting road as well as extractive uses. In many cases, as with urban or commercial development, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. In other situations, such as conversion to pine plantations, the mixed forest habitat is lost, but the newly planted forest can be managed for several years to provide open young forest habitats that support a diversity of landowner goals, wildlife species, and recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below).

2. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note is the gypsy moth. Although more prevalent in the western portion of the state, it may still affect oaks and other species within these forests (DOF 2014).

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in Southside Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Water Quality Improvement Plan to Reduce Bacteria in Darden Mill Run, Mill Swamp, and Three Creek* developed by DEQ and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Three Creek watershed to help decrease sediment run off as well as provide wildlife habitat (Working Group 2013).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing

unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the Southside Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SGCN. Conservation and management efforts may need to focus on trees that can better withstand higher salinities, increased temperatures, and drought, among other impacts. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for action plan species. Open habitats are often comprised of post agricultural lands, long leaf pine savannas, glades and barrens, and outcrop and summit scrub. These habitats make up approximately 130,575 acres (9.8 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species, such as the loggerhead shrike and grasshopper sparrow that can depend on these areas for nesting, feeding, protection, etc. Pine savanna provides habitat for the Bachman's sparrow and oak toad.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Halifax County offers some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management. The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as

	restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will be borne out in the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Southside Planning Region, priority conservation opportunities include:

- Protecting the quantity and quality of water.
- Maintain and conserve patches of mixed hardwood conifer forests.
- Maintaining open habitats and pursuing opportunities to restore native grasslands where possible.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN SOUTHSIDE PLANNING REGION

Complete SGCN list for the Southside Planning Region (SGCN=89). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		III	a	Dwarf waterdog	*Necturus punctatus*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		IV	a	Many-lined salamander	*Stereochilus marginatus*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Amphibian		II	a	Oak toad	*Anaxyrus quercicus*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird	**ST**	I	a	Bachman's sparrow	*Aimophila aestivalis*
Bird		III	c	Bank swallow	*Riparia riparia*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Black-bellied plover	*Pluvialis squatarola*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*

Bird	**ST**	I	a	Loggerhead shrike	*Lanius ludovicianus*
Bird		IV	b	Marsh wren	*Cistothorus palustris*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	a	Short-billed dowitcher	*Limnodromus griseus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FS**	III	c	Chowanoke crayfish	*Orconectes virginiensis*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*
Fish		III	c	Freshwater drum	*Aplodinotus grunniens*
Fish		III	c	Ironcolor shiner	*Notropis chalybaeus*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish		III	c	Snail bullhead	*Ameiurus brunneus*
Fish		IV	c	Speckled killifish	*Fundulus rathbuni*
Fish	**ST**	II	c	Whitemouth shiner	*Notropis alborus*
FW Mollusk		IV	a	Alewife floater	*Anodonta implicata*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Carolina slabshell mussel	*Elliptio congaraea*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk		IV	a	Eastern pondmussel	*Ligumia nasuta*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*

FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	c	Ridged lioplax	*Lioplax subcarinata*
FW Mollusk	**FS**	II	b	Roanoke slabshell	*Elliptio roanokensis*
FW Mollusk		IV	a	Tidewater mucket	*Leptodea ochracea*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Mammal		IV	c	Marsh rabbit	*Sylvilagus palustris palustris*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Other Terrestrial Invertebrate	**FS**	II	c	A millipede	*Auturus erythropygos*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		IV	a	Mudsnake	*Farancia abacura abacura*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*
Reptile		IV	b	Yellow-bellied slider	*Trachemys scripta scripta*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

24. THOMAS JEFFERSON PLANNING REGION LOCAL ACTION PLAN SUMMARY

WILDLIFE ACTION PLAN AND LOCAL SUMMARIES OVERVIEW

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN are already listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

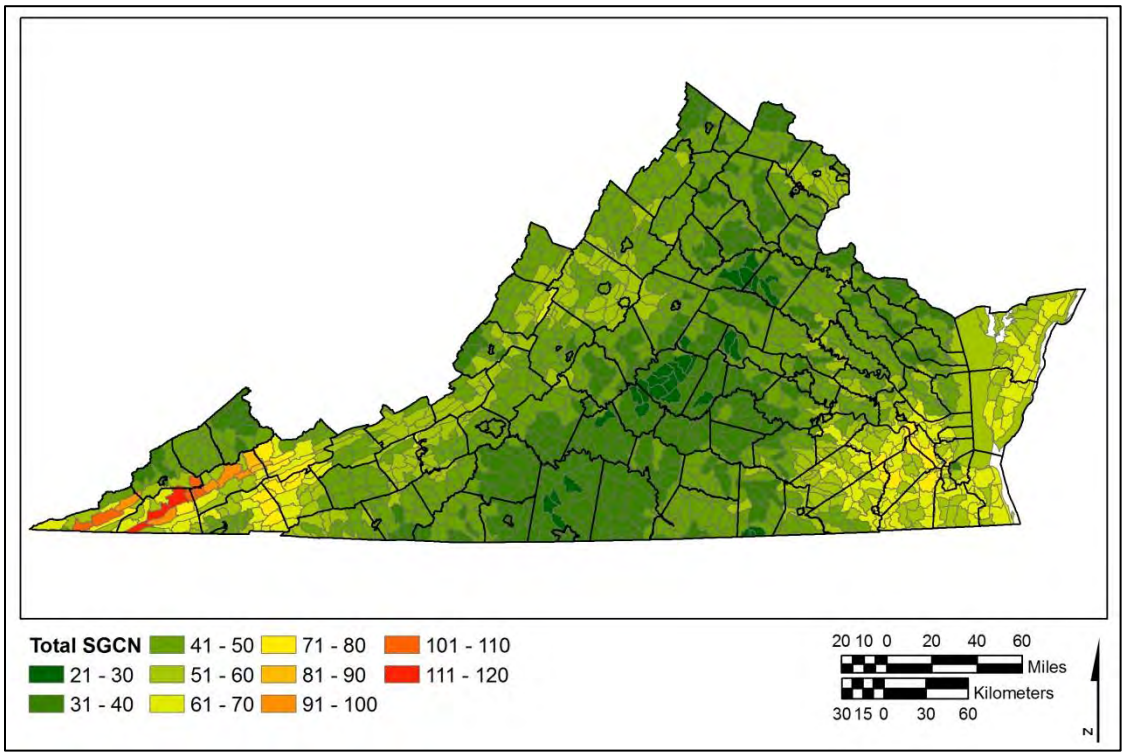

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

THOMAS JEFFERSON PLANNING REGION SUMMARY OVERVIEW

The Thomas Jefferson Planning Region consists of 1,389,635 acres (2,171 square miles) and includes the counties of Albemarle, Fluvanna, Greene, Louisa, and Nelson and the city of Charlottesville. The human population in this planning region is estimated to be over 244,000 (U.S. Census Bureau 2015). Significant human population growth is expected by 2020, ranging from a rate of 3.2 percent in Nelson County to almost 23 percent in Louisa County (DCR 2013).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or extractive uses expand. This planning region contains aquatic habitats for a range of SGCN, including Virginia Piedmont water boatman, James spinymussel, and green smooth snake. Its karst systems provide habitat for the Blue Ridge springsnail. The planning region also includes a variety of other habitats such as mixed hardwood and conifer forests, young forests, retired agricultural land, non-tidal wetlands, and warm and cold water freshwater streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

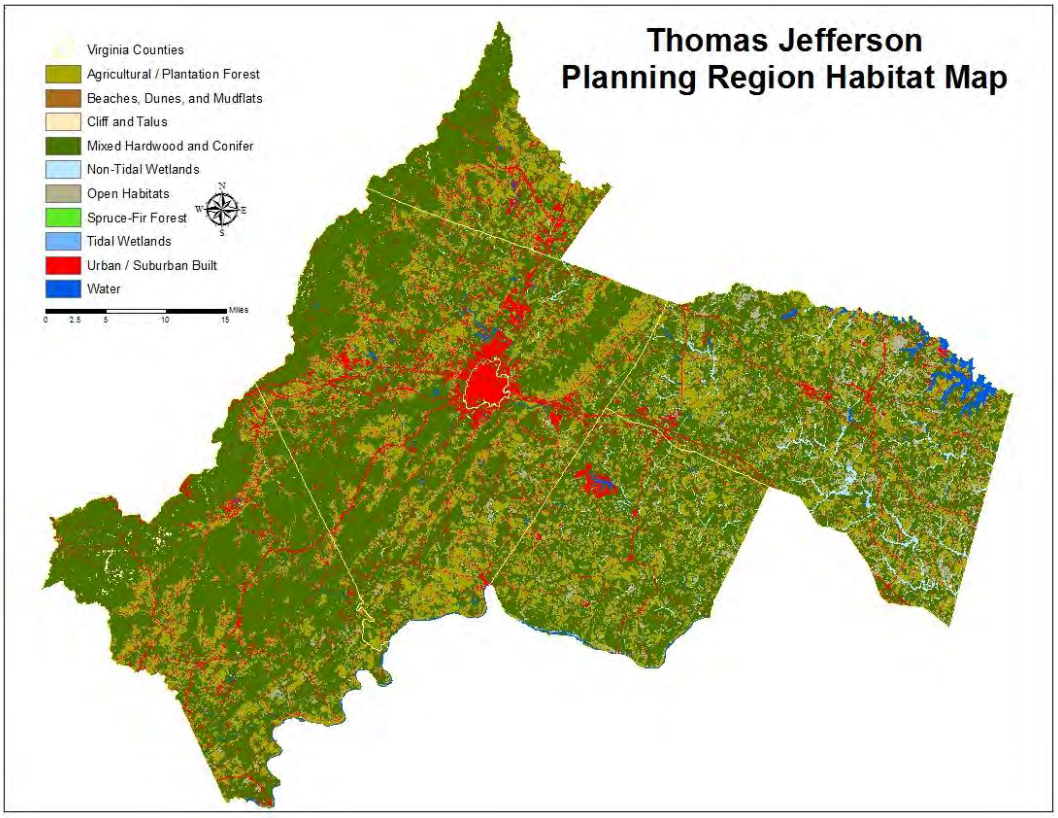

Figure 2. Thomas Jefferson Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 88 are believed to either occur, or have recently occurred, within the Thomas Jefferson Planning Region (Appendix A). Of these 88 species, ***42 SGCN are dependent upon habitats provided within the Thomas Jefferson Planning Region (*** Figure ***2). These species constitute the priority SGCN for the region.*** A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 42 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical

for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	1
Ib	2
Ic	2
IIa	3
IIc	1
IIIa	7
IIIb	1
IIIc	3
IVa	13
IVb	7
IVc	2

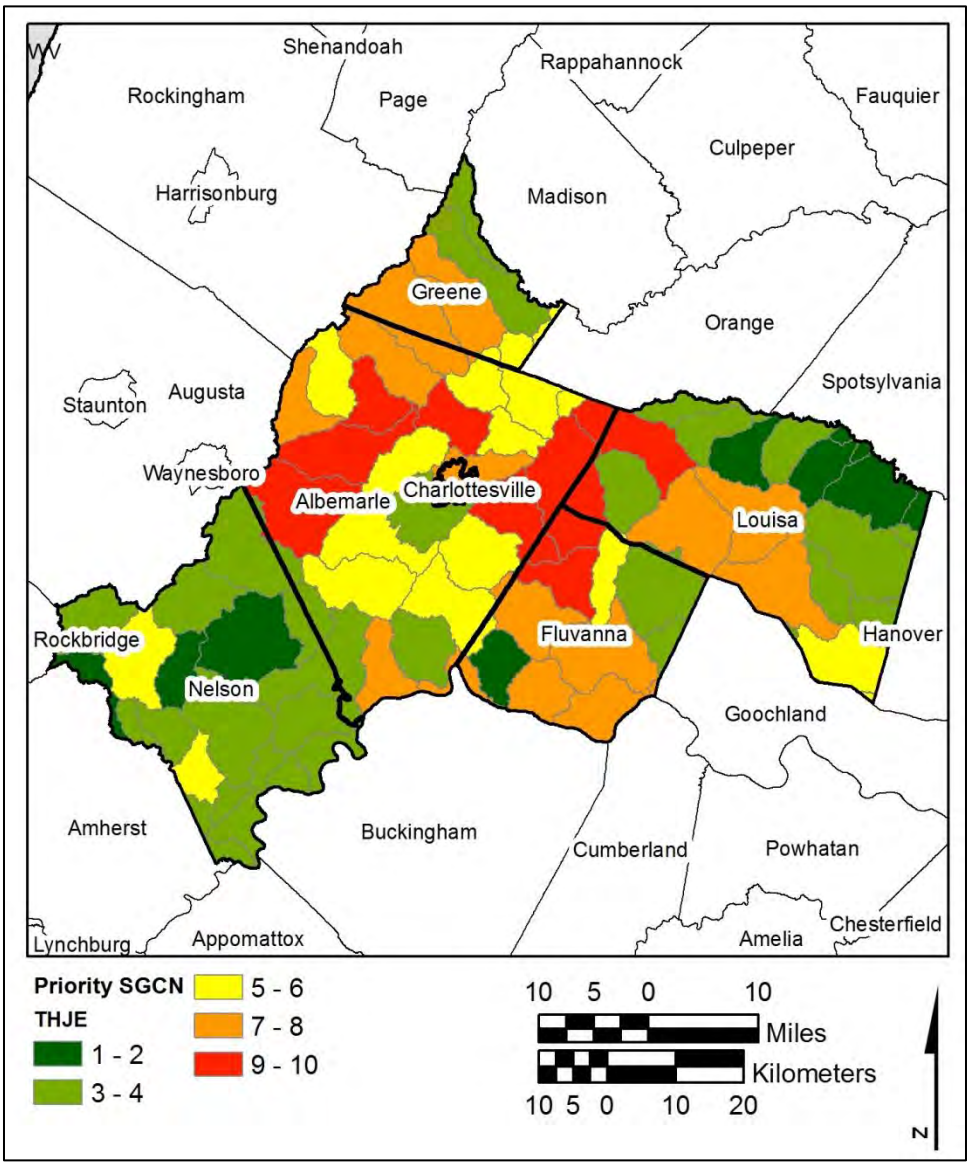

Figure 3. Priority SGCN Density in the Thomas Jefferson Planning Region (HUC12 Watersheds).

Table2. Priority Species of Greatest Conservation Need Distribution in the Thomas Jefferson Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Bird		III	c	Bank swallow	*Riparia riparia*	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.
Bird		III	a	Barn owl	*Tyto alba*	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation
Bird		III	b	Belted kingfisher	*Megaceryle alcyon*	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*	Habitat generalist with broad habitat tolerances
Bird		IV	a	Brown thrasher	*Toxostoma rufum*	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Canada warbler	*Cardellina canadensis*	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growt
Bird		II	a	Cerulean warbler	*Setophaga cerulea*	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy
Bird		IV	b	Chimney swift	*Chaetura pelagica*	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*	Winter resident shorelines and estuaries
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	*Sturnella magna*	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats
Bird		III	a	Eastern whip-poor-will	*Caprimulgus vociferus*	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	*Contopus virens*	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests

Bird		IV	a	Field sparrow	*Spizella pusilla*	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*	Grassland obligate
Bird		IV	a	Gray catbird	*Dumetella carolinensis*	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	*Butorides virescens*	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Northern bobwhite quail	*Colinus virginianus*	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests
Bird		IV	b	Northern Flicker	*Colaptes auratus*	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River
Bird		III	a	Ruffed Grouse	*Bonasa umbellus*	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*	Wooded swamp and wooded wetland winter habitat
Bird		IV	b	Wood thrush	*Hylocichla mustelina*	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	*Icteria virens*	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Crustacean	**FSST**	I	b	Madison Cave amphipod	*Stygobromus stegerorum*	Caves with clean abundant water flowing through the system
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish	**FS**	II	a	Yellow lance	*Elliptio lanceolata*	Requires slow currents with unsilted sandy substrates and can tolerate a various water sizes
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*	Areas with moderate current and sand, rocky, or mud bottom
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*	Springs and cave streams in the Potomac basin and along the Blue Ridge
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*	Clean flowing water with sand and gravel substrates and aquatic vegetation
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes

						and ponds, particularly in outlets
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*	Clean, calm water in streams and rivers of various sizes with sand and gravel substrates
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*	Clear flowing water with sand, gravel, or cobble substrates
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*	Clean streams with stable banks and sand or gravel substrates
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*	Clean streams with stable banks and sand or gravel substrates
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil
Insect	**FSSE**	I	c	Virginia Piedmont water boatman	*Sigara depressa*	Streams with clean water and healthy riparian areas site; this species has only been found at one site
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius coecus*	Caves with clean abundant water flowing through the system
Other Terrestrial Invertebrate		III	c	Depressed glyph	*Glyphyalinia virginica*	No habitats have been identified for this terrestrial snail
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*	Moist meadows or grassy areas at the edges of bogs or small streams

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Proposed (FP), and Species of Collection Concern (CC).

Conserved Lands in Thomas Jefferson Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national parks and forests to state parks, forests, and wildlife management areas to conservation easements. Significant conservation assets, in terms of size, include:

- Shenandoah National Park,
- George Washington and Jefferson National Forest,
- Rapidan Wildlife Management Area,
- James River Wildlife Management Area,
- Hardware River Wildlife Management Area,
- James River State Park,
- Biscuit Run State Park,
- Lesesne State Forest,
- Crawfords Knob State Natural Area Preserve,
- Pigeon Top Mountain Preserve,
- Ragged Mountain Natural Area,
- Ivy Creek Natural Area, and
- Scheier Natural Area.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

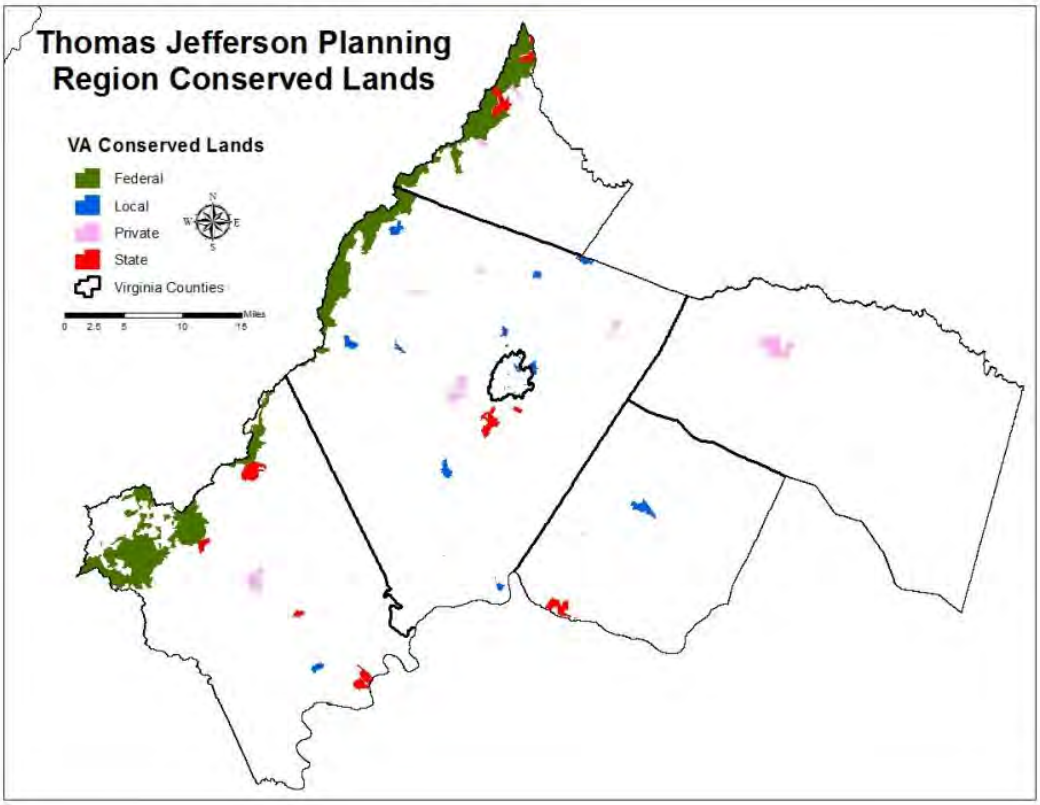

Figure 2. Conservation Lands in the Thomas Jefferson Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within Crater Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. Additionally, although there may be concern over the economic and social impacts of putting lands into conservation, many of these areas provide recreation and ecotourism benefits (DCR 2013; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the Thomas Jefferson Planning Region

Changes in temperature and precipitation will likely negatively affect habitats and SGCN in the Thomas Jefferson Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions to Wildlife and Habitats in the Thomas Jefferson Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many Thomas Jefferson Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for the Thomas Jefferson Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Protect karst habitats	1) Maintain vegetative cover within watersheds where subterranean species occur; 2) Establish vegetative buffers around springs and sinkholes; 3) Minimize nutrients and sediments flowing into the system; 4) Establish parks, greenways, or other conserved lands above karst systems; 5) Develop water conservation and use strategies to help minimize groundwater depletion; and 6) Better manage fecal matter and sewage.	Commercial/residential water consumption, sedimentation and pollutants; protection of cave entrances	Drinking water quality; sustainability of private landowner wells and residential water supply	Areas underlain by karst geology
Maintain and restore wetland habitats	1) Work with appropriate entities on wetlands permitting process to ensure adequate mitigation and restoration procedures are in place; 2) Establish or enhance vegetative buffer areas inland of existing wetlands; 3) Utilize relevant data (e.g., Virginia Department of Conservation and Recreation's wetlands catalog to identify priority areas for conservation, acquisition, and restoration; and 4) Control invasive species.	Water quality degradation, habitat/ land use conversion, non-native and exotic invasive species	Flood control; filtration services; erosion and sediment control; supports recreational and commercial fisheries; ecotourism/ wildlife watching and fishing/ hunting opportunities	Watershed with priority wetlands
Enhance, maintain, and restore aquatic and riparian habitats	1) Restore or establish vegetated riparian buffers on streams flowing through agricultural lands; 2) Exclude livestock from streams; 3) Establish permanent vegetative cover on critical areas; 4) Reforest highly erodible pasture and croplands; 5) Utilize cover crops and no-till techniques on crop lands; 6) Restore and create wetlands; 7) Repair or replace failing septic systems and eliminating "straight pipes;"8) Restore and create urban forest buffers; 9) Enhance street sweeping efforts; 10)Work to reduce the amount of impervious surface; 11) Implement various urban storm water management techniques, such as urban forested buffers, wetland restoration, permeable pavement, and rain gardens to slow the flow of storm runoff into streams and allow infiltration into the soil; 12) Continue to identify impaired	Water quality degradation, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Goldmine Creek, Meadow Creek, Moores Creek, Moores Creek, Rockfish River and Tye River

	waters within the planning region; 13) Remove barriers to aquatic connections; 14) Monitor and address invasive species impacts; and 15) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.			
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; 5) Monitor and control invasive species; and 6) Facilitate deer control efforts.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels
Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter rivers or karst systems	Areas supporting SGCN that are not already protected

Protect Karst Habitats

The Thomas Jefferson Planning Region contains cave/ karst habitats that are relatively unique in Virginia (Figure 5). These features are created by complex interactions of water, bedrock, vegetation, and soils. Karst areas contain sinkholes, sinking and losing streams, caves, and large flow springs (DCR website 2014). Karst systems provide important habitats for one priority SGCN within this planning region, the Blue Ridge springsnail.

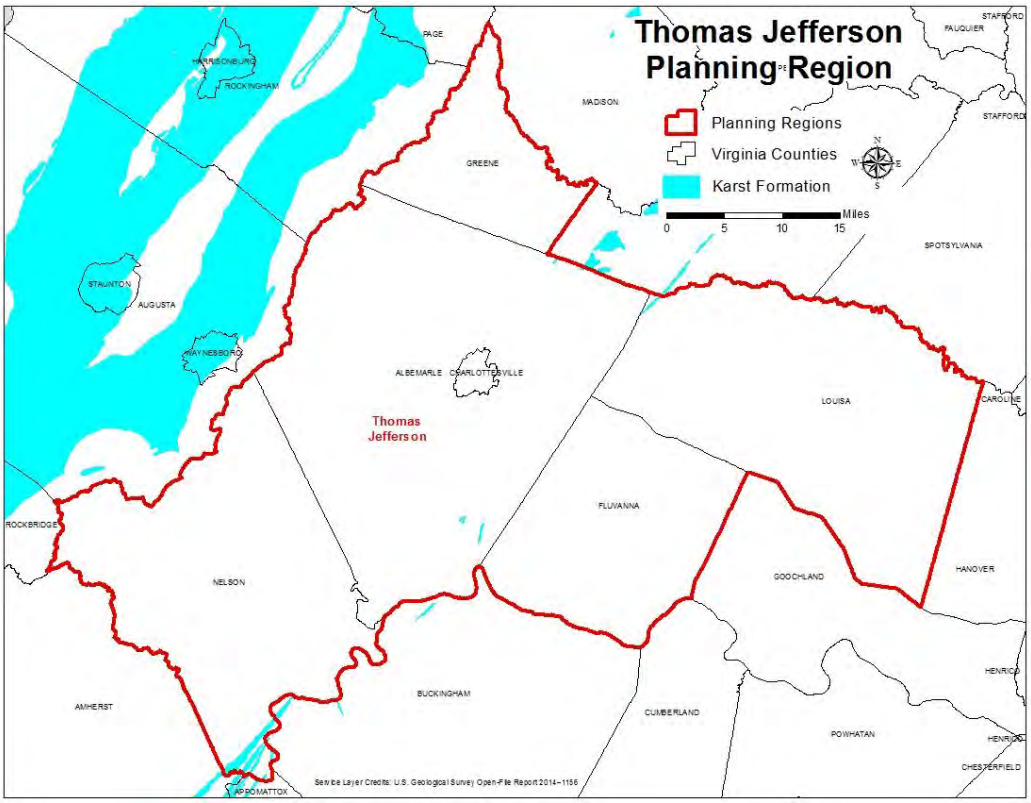

Figure 5. Karst Formations in Thomas Jefferson Planning Region (Weary and Doctor 2014).

Threats

Threats are primarily water-related for karst systems.

1. Water Quality Degradation: Water is the most critical element influencing the health of a karst system. The quality of water entering, and flowing through, Virginia's karst systems, is affected by a variety of issues. Nutrient pollution, especially from nitrogen and phosphorus, is a significant cause of water degradation as well as bacteria, fertilizer, and pesticides (DCR 2008). Nutrients often enter aquatic systems from lands without adequate best management practices (BMP), storm water runoff controls, or adequate waste treatment practices. Water quality degradation of karst systems often occurs when sinkholes are used as disposal sites.

Development and resulting pollutant-laden runoff also negatively affect water quality (DCR 2008).

2. Altered Hydrology: The amount of water flowing through the system is also important. Withdrawals for human use have the potential to degrade subterranean habitats and change surface topography. Development and other activities which increase the amount of impervious surface can also play a role in changing water flow patterns and altering how much water flows into a karst system.

3. Climate Change: Changes to precipitation regimes that may cause more intense storm events could exacerbate already existing water quality problems. Higher amounts of precipitation in a short time frame could dramatically affect storm water runoff and nutrient run off from impervious surfaces.

Conservation Management Actions

The most efficient and cost effective means of conserving the integrity of karst and cave habitats is to focus on preserving the quality and quantity of water flowing into these systems. To improve water quality, important management actions include: minimizing use of fertilizers and pesticides near karst sites, minimizing runoff and other pollutants around the areas, preventing disposal of residential or agricultural waste near these sites, and ensuring vegetative buffer areas where there are extractive or other intensive land uses (Veni et al. 2001). It is also important to prevent sewage from community or municipal sewer systems from contaminating ecologically sensitive groundwater systems in karst areas (B. Beaty, The Nature Conservancy, personal communication, 2015). Vegetative buffers around sinkholes and entrances work to maintain the quality of water flowing into karst systems and provide vegetative cover in areas underlain by karst geology. However, it is important to note that it can be difficult to identify surface areas above the subterranean system well enough to install appropriate buffer areas.

Additionally, working with residents and municipalities to develop water conservation strategies will be important to control water withdrawals in the area (Veni et al. 2001). Adopting land use practices or policies through zoning or other guidelines focused on karst systems may also help protect and improve the health of karst systems in sensitive areas. Establishing conserved or recreational areas around these karst systems may also be valuable. Local government policies or ordinances could include overlay districts, karst feature buffers, geotechnical surveys when in area that could contain karst systems, and/ or performance standards for development (Belo 2003).

Climate-Smart Management Actions

Karst systems are vulnerable to stressors such as poor water quality and changes to water flow that may be exacerbated by climate change. When considering planting vegetative buffers, managers will need to understand how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become flashier due to increased precipitation, or more frequent flooding is projected to occur, tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Vegetation species that are better able to withstand these conditions may be better suited to help mitigate the impacts of flooding and increased runoff.

Minimizing impervious surface (see following section) will be even more important under climate change as with increased storm intensity will result in more stormwater runoff.

Maintain and Restore Wetland Habitats

Non-tidal wetlands are found throughout the Thomas Jefferson Planning Region and make up approximately 1.7 percent of the region (24,000 acres) (Anderson et al. 2013). In addition to providing habitat for a diversity of aquatic and terrestrial species, wetlands help maintain water quality and quantity within a watershed, limit erosion caused by floods, and provide recreational opportunities for hunters, anglers, and wildlife watchers. These wetlands provide valuable habitats for the rusty blackbird and smooth greensnake, among others.

Threats

The health and quality of non-tidal wetlands are affected by a variety of issues, both natural and anthropogenic. As the quality of a wetland degrades, so does the value of that wetland to Virginia's wildlife.

1. Water Quality: Wetlands help filter nutrients and other pollutants from watersheds, but they are also sensitive to activities that impair water quality and overload the system (Hemond and Benoit 1986). When best management practices are not implemented upstream, runoff laden with nutrients, sediment, and other pollutants enter the system in concentrations that hinder the wetland's filtering capacity. Storm water runoff from urban and developed areas also contributes to water quality issues that degrade wetlands (Hemond and Benoit 1986). Nutrient pollution and sedimentation are important issues for tidal and non-tidal wetlands throughout the planning region.

2. Land Use Changes: One of the most significant threats to these non-tidal wetlands is conversion to other uses that results in a loss of wetland integrity and function. As more areas are developed for additional human uses, wetland areas will likely be lost.

3. Invasive Species: Invasive species often degrade quality of wetland habitat through damage or loss to wetland vegetation. Examples of invasive species affecting these non-tidal wetlands include purple loosestrife and exotic invertebrates.

4. Climate Change: As precipitation regimes change and temperatures likely increase, water availability may change. For example, in summer months droughts may become more frequent and water availability may decrease.

Conservation Management Actions

A number of actions can be taken to address threats affecting wetlands in the Thomas Jefferson Planning Region. To address development and fill impacts, the federal government and the Commonwealth of Virginia has established an extensive wetlands permitting process to help landowners and developers avoid impacts to wetlands while pursuing their management objectives. The U.S. Army Corps of Engineers has authority to issue permits for impacts to non-tidal wetlands through the federal

Clean Water Act, while DEQ has authority under Virginia's State Water Control Law. Permits are issued through a Joint Permit Application Process that can be initiated with DEQ (DEQ 2011). Mitigation to compensate for wetland loss is often required under these permits. However, wetlands restoration to reestablish or rebuild former wetland areas or restore functions to a degraded wetland also are voluntary conservation actions agencies and conservation partners can implement outside of required wetlands mitigation and are an important component to protecting wetlands (DEQ 2011). These types of conservation actions also help provide migration corridors for migratory birds that depend on wetlands for nesting, roosting, and foraging. Various programs implemented by the Natural Resources Conservation Service (NRCS) and other partners also provide guidance related to conserving wetlands, establishing oyster reefs, and implementing other actions.

Establishing or protecting vegetative buffers upland of wetlands is important to protect health of the existing wetlands as well as to provide a potential migration route as conditions change (Kane 2011). Protection of additional wetland areas through acquisition, easement, or agreement would allow for further conservation of this important habitat and associated SGCN. Finally, working to limit invasive plants and animals and predators that might degrade the quality of these habitats will be important conservation actions.

Priority areas for wetlands protection and restoration within the Thomas Jefferson Planning Region include those wetlands that allow for large wetland complexes to be protected, ensuring larger habitat patches remain available for wildlife. Areas identified by conservation partners, such as the Virginia Department of Conservation and Recreation (DCR), as outstanding opportunities for conservation should also be considered priorities for protection and conservation. An initial review of the Virginia Wetlands Catalog identifies priority wetlands for conservation and restoration (Weber and Bulluck 2014). Designation of these areas was based on several factors, including existing plant and animal diversity, presence of significant natural communities, presence of natural lands providing ecosystem services, presence of corridors and stream buffers, proximity to conserved lands, inclusion within or downstream of healthy watersheds, and location of drinking water sources (Figure 6) (Weber and Bulluck 2014). DCR also designates potential restoration sites, identified based on similar factors as conservation areas, but also including consideration of inclusion within degraded watersheds, proximity to impaired waters, location of existing wetland mitigation banks, presence of prior converted and farmed wetlands, and inclusion of stream reaches with lower aquatic biodiversity (Figure 7) (Weber and Bulluck 2014). Wetland conservation priorities exist adjacent to already conserved lands in Fluvana and a significant amount of very high priority areas are in Albemarle County. The sites with the highest potential for restoration occur in Greene and Albemarle counties.

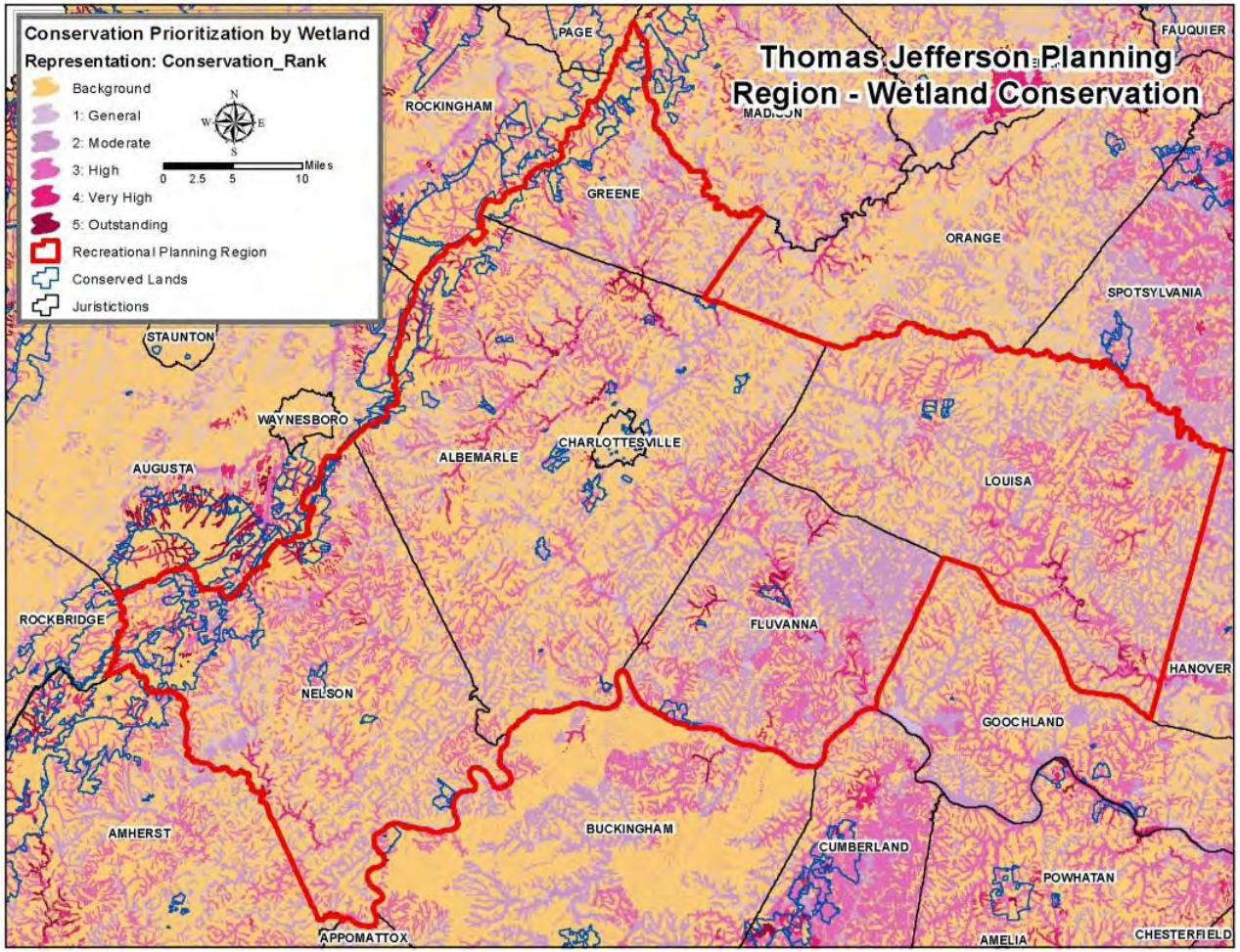

Figure 6. Wetland Conservation Priority Areas in Thomas Jefferson Planning Region (Weber and Bulluck 2014).

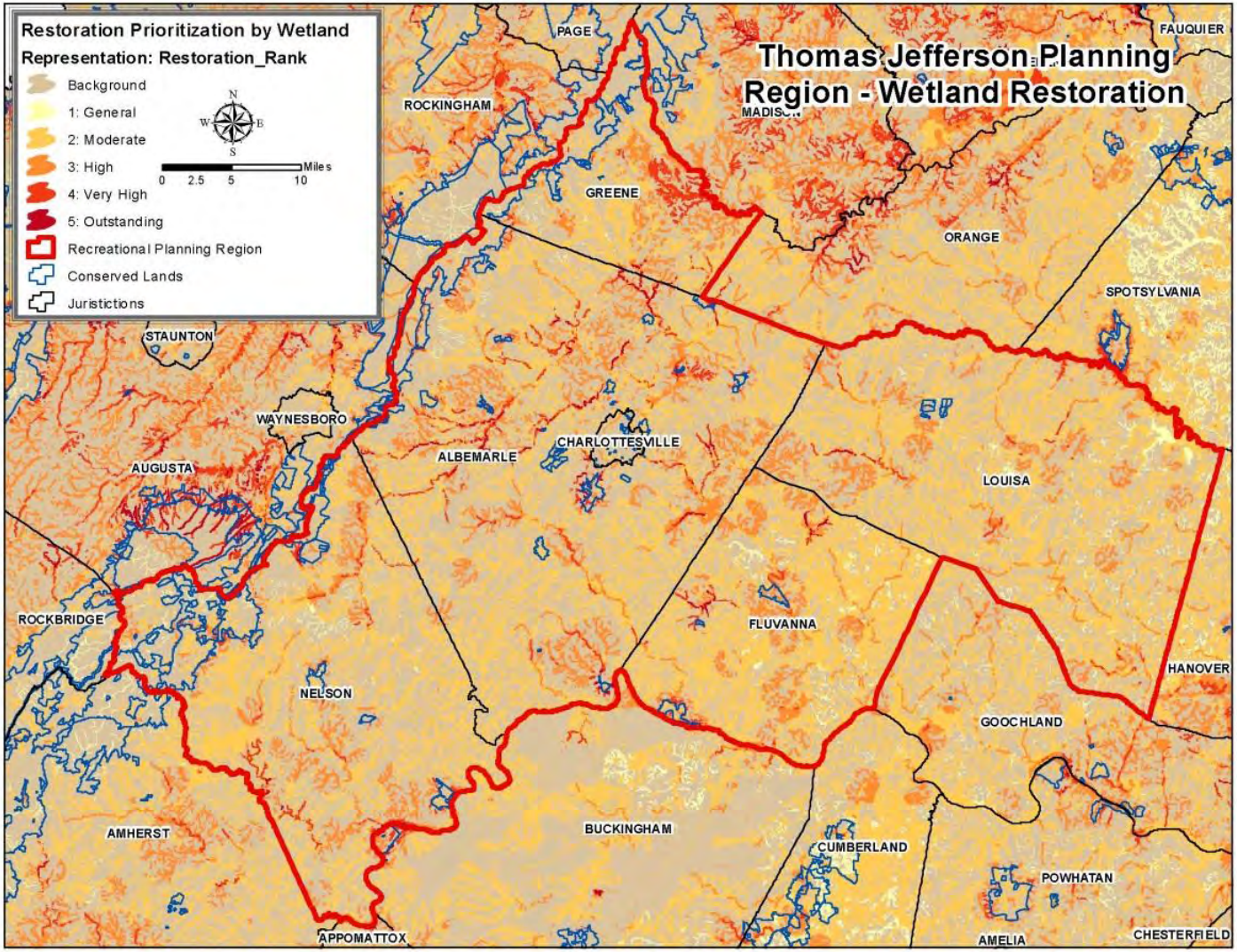

Figure 7. Wetland Restoration Priority areas in Thomas Jefferson Planning Region (Weber and Bulluck 2014).

Climate-Smart Management Actions

Additional wetlands climate-related conservation actions include: restoring and enhancing vegetation within the wetlands to support changing conditions (e.g., using vegetation species that can withstand a broader array of conditions such as more frequent inundation) and enhancement of wetlands by targeted restoration or acquisition in areas where impacts from climate change may be mitigated.

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the Thomas Jefferson Planning Region include warm and cold water, freshwater rivers, streams, and creeks. Large river systems include the James and Rivanna Rivers as well as smaller creeks and streams. Approximately 20,300 acres (1.5 percent) of the planning region is considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include the Virginia Piedmont water boatman (100 percent of its range within this planning region), James spinymussel, notched rainbow, Atlantic spike, and green floater.

Threats

Aquatic and riparian habitats within the Thomas Jefferson Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the Thomas Jefferson Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014a). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although most of the Thomas Jefferson Planning Region generally has a low percentage of impervious surface cover, some areas such as around cities have a larger percent of impervious surface cover (Figure 8).

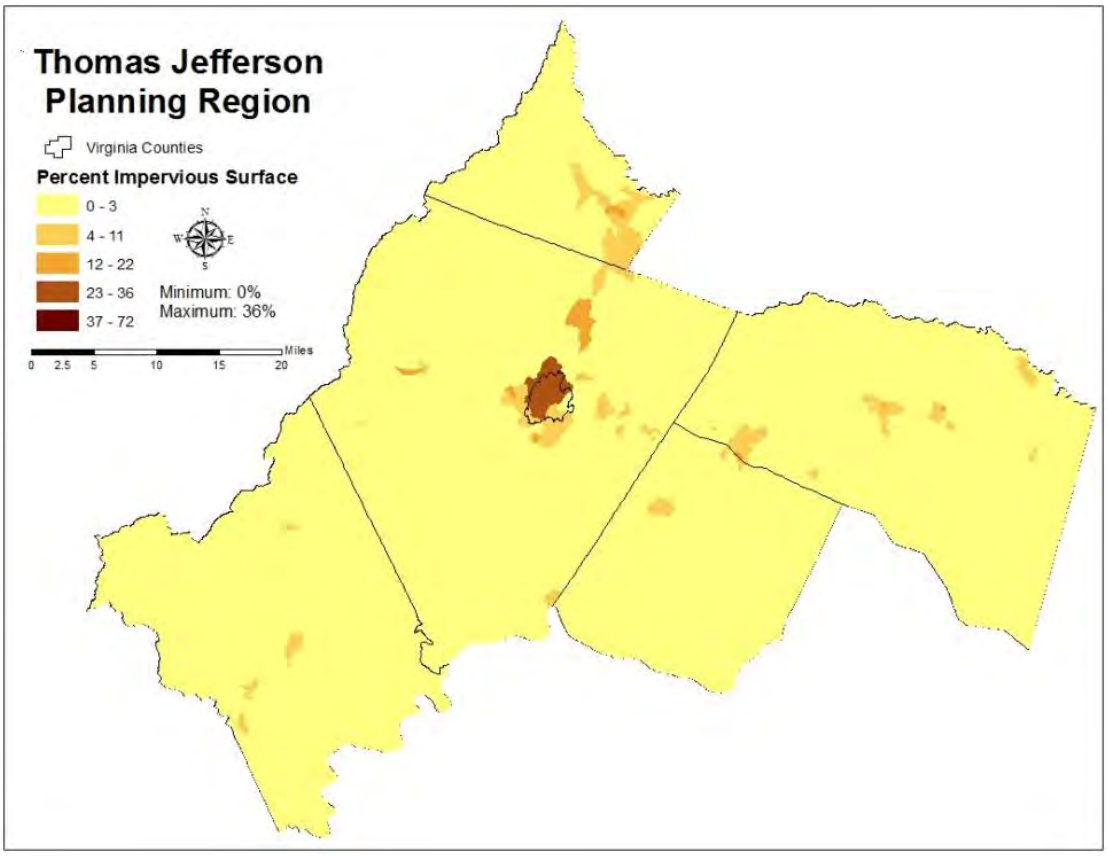

Figure 8. Impervious Surface Cover in Thomas Jefferson Planning Region (SARP 2014).

3. Invasive Species: Additional threats to aquatic systems within Thomas Jefferson Planning Region include invasive species that consume native species or consume aquatic vegetation, thereby altering the quality of these aquatic habitats.

4. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

5. Water Withdrawals: Water withdrawals for human and land uses can also alter stream hydrology and cause stress to aquatic species that depend on specific water levels and flow rates.

6. Climate change: Climate change will also affect aquatic systems in this planning region. Changes in temperature and precipitation regimes could result in drier more drought prone summers. Water temperatures may also be affected, resulting in potential harm to fish and other aquatic species.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Goldmine Creek (Blue Ridge Environmental Solutions, 2011), Meadow Creek, Moores Creek (Virginia Tech 2012), Moores Creek (Rivanna River Basin Commission 2012), Rockfish River (DEQ and DCR 2013), and Tye River (DEQ 2014b) (Figure 9).

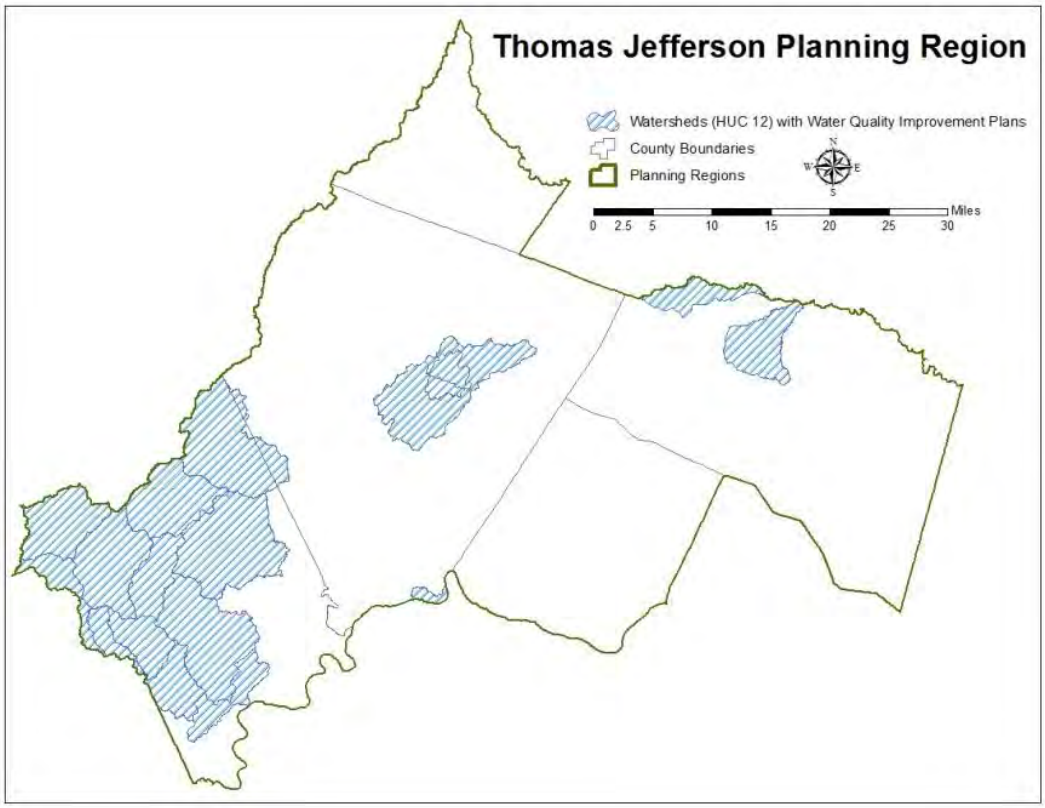

Figure 9. Watersheds with Water Quality Improvement Plans.

Each of these watersheds is designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Restoring or establishing vegetated riparian buffers on streams flowing through agricultural lands;
- Excluding livestock from streams;
- Establishing permanent vegetative cover on critical areas;
- Reforesting highly erodible pasture and croplands;
- Utilizing cover crops and no-till techniques on crop lands;
- Restoring and creating wetlands;
- Repairing or replacing failing septic systems and eliminating “straight pipes” depositing human waste into streams;
- Restoring and creating urban forest buffers;
- Enhancing street sweeping efforts;

- Working to reduce the amount of impervious surface within the watershed; and
- Implementing various storm water management techniques, such as urban forested buffers, wetland restoration, permeable pavement, and rain gardens to slow the flow of storm runoff into streams and allow infiltration into the soil.

Members of Virginia's conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 10).

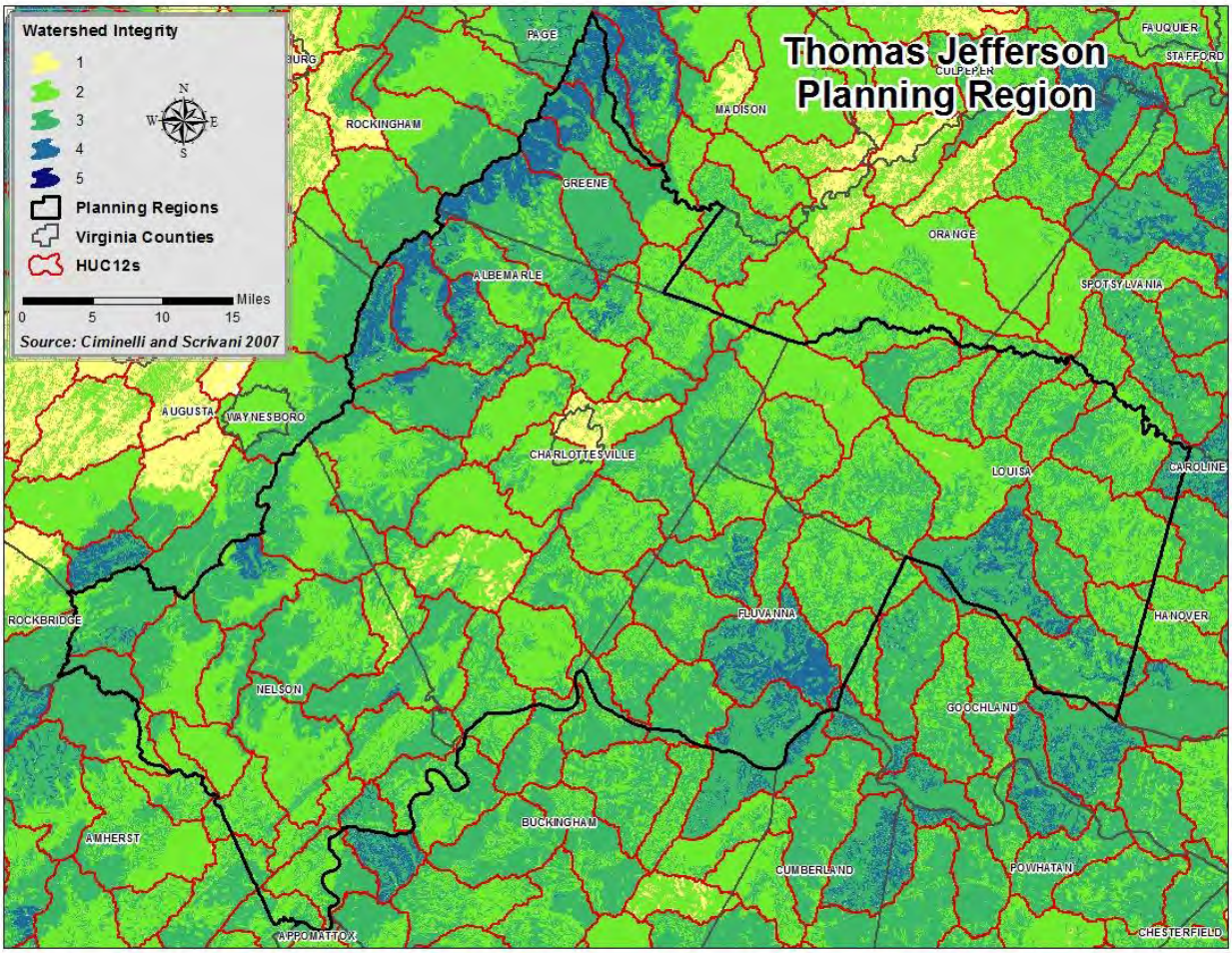

Figure 10. Watershed Integrity Model for Thomas Jefferson Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Reducing impervious surface by replacing with more porous materials or vegetation;

- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the Thomas Jefferson Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established BMPs for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). NRCS provides landowners with other opportunities including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 11) (Martin and Apse 2013).

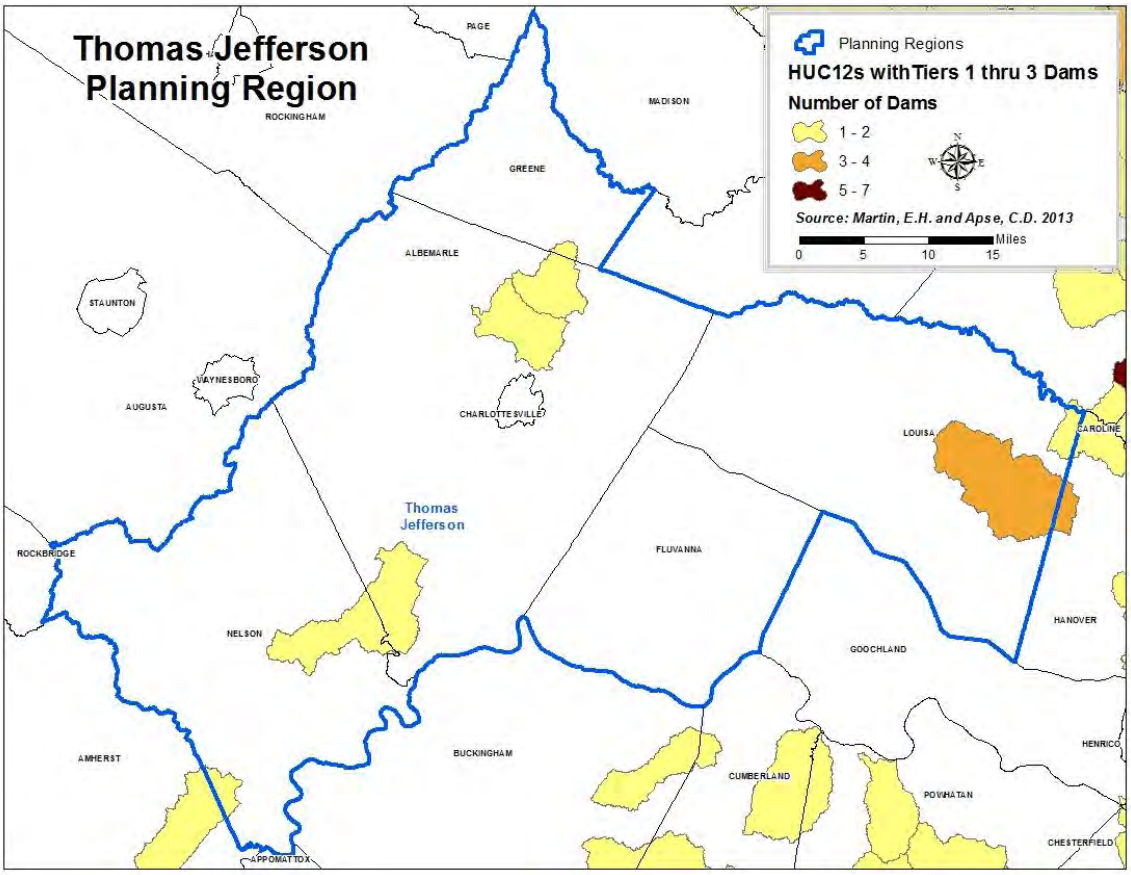

Figure 11. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the Thomas Jefferson Planning Region include monitoring and addressing invasive species impacts and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up almost two thirds of the Thomas Jefferson Planning Region and are important for a broad range of species (Table 4). Young forest habitat can be loosely defined as referring to areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. Spruce-fir forests make up a small percentage of the forest types within this planning region, while the majority of the forested lands are made up of mixed hardwoods (oak and hickory) and conifers. These forests help protect water resources within the region and provide habitat for species such as the Northern saw-whet owl, cerulean warbler, ruffed grouse, and barn owl, among other species.

Table 4. Forest Acreage Totals in Thomas Jefferson Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent Planning Region
Spruce Fir	14.68	0.0%
Mixed Hardwood and Conifer	857,352.37	61.75%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the Thomas Jefferson Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Energy development (wind energy and the potential for natural gas) could also degrade habitat and affect species composition and water quality.

2. Lack of Young Forest Conditions: During recent decades, managers of federal and state-owned forests have managed properties for mature forest conditions. While mature forests provide habitat for a variety of species, the lack of young forest conditions in the western parts of Virginia has curtailed distribution of many species that rely upon open habitats. Forests with balanced age classes are critical for the health of the forest and the survival of forest dependent wildlife species.

3. Invasive Species: Invasive plant species and pests are also a significant problem in this region. Of particular note are the hemlock wooly adelgid and the gypsy moth, which has a significant effect on the ecology of oak-hickory forests (DOF 2014).

4. Overabundance of Deer: Virginia's Draft 2015-2024 Deer Management Plan indicates the deer population in Albemarle County needs to be reduced in order to meet a variety of social and ecological goals (DGIF 2015a). An overabundance of deer often hinders forest regeneration, impacts populations of sensitive native plants, and eliminates habitats for ground-nesting birds and other understory species. In many cases, deer overbrowse can facilitate colonization by invasive species such as privet or Japanese stilt grass. These invasive species are not palatable to deer, easily colonize these disturbed habitats, and provide few habitat benefits to native wildlife. Urban and suburban environments compound the issue as they often limit hunting opportunities that might otherwise help control deer numbers.

5. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests (the majority of spruce fir forests are already under some form of conservation) in the Thomas Jefferson Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development. Additionally, working with landowners to ensure BMPs such as

vegetative buffers are in place around agricultural operations or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Upper York River Basin Watershed Implementation Plan* developed by DCR and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within Goldmine Creek watershed to help decrease sediment run off as well as provide wildlife habitat, and *Water Quality Improvement Plan for Tye River, Hat Creek, Rucker Run, and Piney River – A Plan to Reduce Bacteria in the Water* makes the same recommendations for Tye River watershed *(*Blue Ridge Environmental Solutions 2011; DEQ 2014).

Several agencies, including DGIF, NRCS, DOF, USFWS and the U.S. Forest Service (USFS) advocate that efforts be expanded to create young forest habitats on public lands. Managing forests via silvicultural practices and/or through the use of fire are the most economical options to create these desired conditions.

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks while also improving quality of wildlife habitats (Brooks and Lusk 2008; DOF 2014).

In terms of addressing deer and their impacts to forested habitats, hunting is the most expedient and efficient means of controlling their populations. DGIF staff and partners feel there are sufficient numbers of hunters to affect a reduced population within this planning region. However, the efficiency of hunting is often limited by a lack of access to areas in need of herd reduction. DGIF currently works with various public and private landowners, property managers, and public officials to facilitate hunting opportunities within the planning region. These efforts will continue. The control of deer numbers is also hindered by a lack of a practical and efficient means to assess deer impacts to local habitats across the state, making it difficult to prioritize areas in need of population control. This issue is discussed several times within Virginia's current Deer Management Plan and will be similarly addressed in the revised 2015-2024 Deer Management Plan (DGIF 2015a). DGIF has initiated research to better understand deer impacts to local ecosystems.

Climate-Smart Management Actions

To best manage forests in the Thomas Jefferson Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Managers may wish to consult the USFS's tree atlas when planning management and conservation of these forests.

Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands and glades and barrens and make up approximately 50,300 acres (3.6 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, protection, etc. These areas provide habitat for the barn owl, northern bobwhite quail, and the Appalachian grizzled skipper, among other species.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

DGIF has recognized that the loss of open habitats, such as glades, savannas, and post-agricultural areas have caused significant declines in several Action Plan species, including the northern bobwhite, loggerhead shrike, field sparrows, eastern towhees, brown thrashers, prairie warblers, regal fritillary, and monarch butterflies. It is likely that the loss of these habitats has contributed to the declines in native pollinator species like bumblebees as well (Xerces Society 2011). To address this issue, Virginia has become a leader in the Northern Bobwhite Conservation Initiative (NBCI). DGIF contributes to this national effort by leading the Virginia Quail Recovery Initiative (QRI), which is a robust, state-based, multi-partner effort dedicated to conserving and restoring open habitats within Virginia. Both the NBCI and the QRI have determined that Green County offers some of the best opportunities for restoring open habitats that support a diversity of open habitat species (DGIF 2007).

Agriculture and forestry are large industries in Virginia, and landowners are important conservation partners. The QRI was created to find opportunities that help private landowners meet their economic goals while also contributing to the conservation and recovery of important wildlife and pollinator species. QRI efforts within this planning region focus on helping landowners manage retired agricultural lands and forested areas to benefit open habitat species, and DGIF provides information for landowners on its quail website (DGIF 2015b).

For landowners seeking to improve the habitat quality of pastures and field edges, the QRI generally recommends removing nonnative grasses and invasive species. In many instances, a sufficient seedbank of native species will exist in the soil to allow the restoration of native plant communities and replanting will likely not be required. Once a native plant community has been established, the QRI recommends managing these habitats either through burning, disking, or (least favorable) mowing. Additionally, within *Managing Pines for Profit and Wildlife* biologists describe landowner opportunities to create a commercially viable forest plot that also benefits open habitat species such as quail (Puckett et al. 2008). Recommendations are provided for site preparation, planting density, pre-commercial thinning, hardwood and grass suppression, commercial thinning, and post-thinning management.

A few patches of glade habitats occur within this planning region. The majority occur on private lands. The key to their conservation will involve working with willing private landowners to conserve and restore those habitats through acquisition, easement, or agreement.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more drought prone. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2012). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2012). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the Thomas Jefferson Planning Region, priority conservation opportunities include:

- Protecting karst habitats.
- Protecting the quantity and quality of water.
- Maintaining existing vegetated wetlands and restoring vegetated wetland habitats where possible.
- Enhance and protect open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN THOMAS JEFFERSON PLANNING REGION

Complete SGCN list for the Thomas Jefferson Planning Region (SGCN=88). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian	**SE**	II	a	Eastern tiger salamander	*Ambystoma tigrinum*
Amphibian		IV	a	Jefferson salamander	*Ambystoma jeffersonianum*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Canada warbler	*Wilsonia canadensis*
Bird		II	a	Cerulean warbler	*Dendroica cerulea*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Dunlin	*Calidris alpina hudsonia*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		I	a	Glossy ibis	*Plegadis falcinellus*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*

Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Northern bobwhite	*Colinus virginianus*
Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		I	b	Northern saw-whet owl	*Aegolius acadicus*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	b	Rusty blackbird	*Euphagus carolinus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean	**FSST**	I	b	Madison Cave amphipod	*Stygobromus stegerorum*
Crustacean	**FTST**	II	c	Madison Cave isopod	*Antrolana lira*
Fish		IV	a	Alewife	*Alosa pseudoharengus*
Fish		IV	b	Allegheny pearl dace	*Margariscus margarita*
Fish		IV	c	American brook lamprey	*Lampetra appendix*
Fish		III	a	American eel	*Anguilla rostrata*
Fish		IV	a	American shad	*Alosa sapidissima*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish		IV	c	Least brook lamprey	*Lampetra aepyptera*
Fish		IV	c	Mud sunfish	*Acantharchus pomotis*
Fish	**FS**	I	b	Roughhead shiner	*Notropis semperasper*
Fish		IV	c	Slimy sculpin	*Cottus cognatus*
FW Mollusk	**FSST**	I	a	Atlantic pigtoe	*Fusconaia masoni*
FW Mollusk		IV	c	Atlantic spike	*Elliptio producta*
FW Mollusk		III	c	Blue Ridge springsnail	*Fontigens orolibas*
FW Mollusk	**SE**	I	a	Brook floater	*Alasmidonta varicosa*
FW Mollusk		IV	c	Carolina lance mussel	*Elliptio angustata*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk	**FESE**	I	a	Dwarf wedgemussel	*Alasmidonta heterodon*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		IV	b	Northern lance mussel	*Elliptio fisheriana*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	a	Triangle floater	*Alasmidonta undulata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
FW Mollusk	**FS**	II	a	Yellow lance	*Elliptio lanceolata*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*

Insect	**FSSE**	I	c	Virginia Piedmont water boatman	*Sigara depressa*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal		IV	c	Long-tailed shrew	*Sorex dispar dispar*
Mammal	**SE**	I	a	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Terrestrial Invertebrate	**FS**	II	c	Cave pseudoscorpion	*Apochthonius coecus*
Other Terrestrial Invertebrate		III	c	Depressed glyph	*Glyphyalinia virginica*
Other Terrestrial Invertebrate		III	c	Variable mantleslug	*Pallifera varia*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*
Reptile		I	a	Northern pinesnake	*Pituophis melanoleucus melanoleucus*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Rainbow snake	*Farancia erytrogramma erytrogramma*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	III	a	Spotted turtle	*Clemmys guttata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

25. West Piedmont Planning Region Local Action Plan Summary

Wildlife Action Plan and Local Summaries Overview

Wildlife Action Plan

Virginia is fortunate to contain a wide variety of natural resources and landscapes that provide Virginians with a range of benefits, services, and economic opportunities. Natural resource conservation in Virginia, as in most states, is implemented by government agencies, non-governmental organizations, private institutions, academic institutions, and private citizens. These groups work to enhance the quality of life within the Commonwealth by conserving Virginia's air, land, water, and wildlife. Adequate funding and human capital needed to manage and conserve these valuable resources are not always available. In 2005, Virginia's conservation community first came together to maximize the benefits of their actions and created the state's first Wildlife Action Plan (Action Plan). It was written to prioritize and focus conservation efforts to prevent species from declining to the point where they become threatened or endangered (DGIF 2005). The 2015 Action Plan is an update of the original Plan. The Action Plan must address eight specific elements mandated by Congress. They are:

> *1. Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife; and*
>
> *2. Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and*
>
> *3. Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and*
>
> *4. Descriptions of conservation actions determined to be necessary to conserve the identified species and habitats and priorities for implementing such actions; and*
>
> *5. Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and*
>
> *6. Descriptions of procedures to review the Plan-Strategy at intervals not to exceed ten years; and*
>
> *7. Plans for coordinating, to the extent feasible, the development, implementation, review, and revision of the Plan-Strategy with federal, state, and local agencies and Indian tribes that manage significant land and water areas within the state or*

administer programs that significantly affect the conservation of identified species and habitats.

8. Congress has affirmed through the Wildlife Conservation and Restoration Program (WCRP) and State Wildlife Grants (SWG), that broad public participation is an essential element of developing and implementing these Plans-Strategies, the projects that are carried out while these Plans-Strategies are developed, and the Species in Greatest Need of Conservation (SGCN) that Congress has indicated such programs and projects are intended to emphasize.

Each species included in the 2015 Action Plan (Species of Greatest Conservation Need or SGCN) has been evaluated and prioritized based upon two criteria: degree of imperilment and management opportunity.

To describe imperilment, SGCN are grouped into one of four Tiers: Critical (Tier I), Very High (Tier II), High (Tier III), and Moderate (Tier IV).

Tier I - *Critical Conservation Need. Species face an extremely high risk of extinction or extirpation. Populations of these species are at critically low levels, face immediate threat(s), and/ or occur within an extremely limited range. Intense and immediate management action is needed.*

Tier II - *Very High Conservation Need. Species have a high risk of extinction or extirpation. Populations of these species are at very low levels, face real threat(s), and/ or occur within a very limited distribution. Immediate management is needed for stabilization and recovery.*

Tier III - *High Conservation Need. Extinction or extirpation is possible. Populations of these species are in decline, have declined to low levels, and/ or are restricted in range. Management action is needed to stabilize or increase populations.*

Tier IV - *Moderate Conservation Need. The species may be rare in parts of its range, particularly on the periphery. Populations of these species have demonstrated a declining trend or a declining trend is suspected which, if continued, is likely to qualify this species for a higher tier in the foreseeable future. Long-term planning is necessary to stabilize or increase populations*.

While degree of imperilment is an important consideration, it is often insufficient to prioritize the use of limited human and financial resources. In order to identify and triage conservation opportunities, development of the updated Action Plan (2015) included assigning a Conservation Opportunity Ranking to each species identified within the Plan. Rankings were assigned with input from taxa or species experts (biologists) and other members of Virginia's conservation community. They also are based on conservation or management actions and research needs identified for the species within the 2005 Action Plan. In addition, a literature review was conducted to garner any new information available since the first version of the Action Plan. The three Conservation Opportunity Rankings are described as follows:

A – Managers have identified "on the ground" species or habitat management strategies expected to benefit the species; at least some of which can be implemented with existing resources and are expected to have a reasonable chance of improving the species' conservation status.

B – Managers have only identified research needs for the species or managers have only identified "on the ground" conservation actions that cannot be implemented due to lack of personnel, funding, or other circumstance.

C – Managers have failed to identify "on the ground" actions or research needs that could benefit this species or its habitat or all identified conservation opportunities for a species have been exhausted.

Over 880 SGCN are listed in the 2015 Action Plan and found in varying densities across the state (Figure 1). Of the Action Plan's SGCN, 23.4 percent are classified as Conservation Opportunity Ranking A; 7.1 percent are classified Conservation Opportunity Ranking B; and 69.5 percent are classified as Conservation Opportunity Ranking C. Additionally, of the 883 SGCN:

- Approximately 25% of the SGCN in the Plan are listed as threatened or endangered under the Federal or Virginia Endangered Species Act,
- Approximately 60% are aquatic,
- Approximately 70% are invertebrates, and
- All are impacted by the loss or degradation of their habitats.

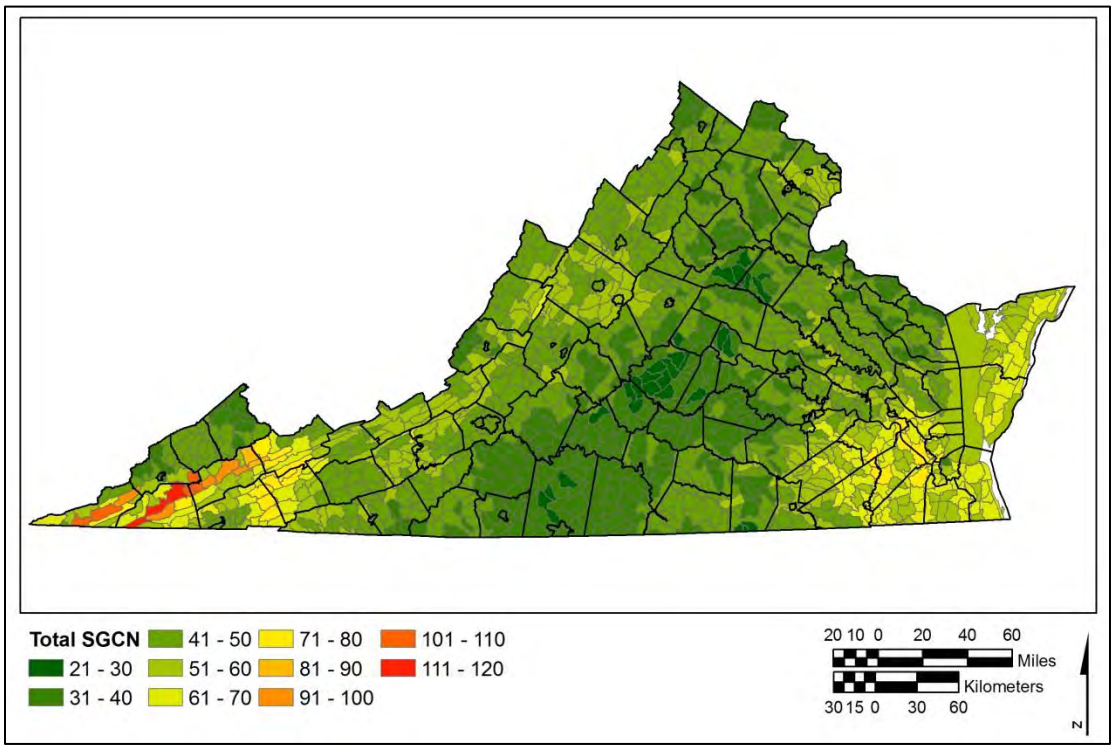

Figure 1. State Distribution of Species of Greatest Conservation Need by HUC12 Watersheds.

Wildlife Action Plan Implementation

Since its creation, the Wildlife Action Plan has helped Virginia acquire over $17 million in new conservation funding through the State Wildlife Grants Program. These resources have been used to implement significant research, advance species recovery efforts via captive propagation, and restore and conserve important wildlife habitats. Despite these successes, many conservation practitioners feel the original Wildlife Action Plan never reached its full potential. One common concern is that it failed to focus at the habitat level where the needs of many species could be addressed at once. Further, many partners indicated the original Action Plan did not provide sufficient details to help prioritize conservation needs and opportunities at a local scale, where many land use decisions are made, and conservation efforts are implemented. Lacking these local insights, it was often difficult for agencies, municipalities, organizations, academic institutions, and landowners to identify and focus on the highest priority wildlife conservation opportunities for their geographic area. To address this concern and make the Action Plan more user-friendly and relevant at a finer scale, this version (2015) of the Action Plan was developed to include locally-based summaries. These summaries identify species that are local priorities, habitats required to conserve those species, regional threats impacting species and habitats, and priority conservation actions that can be taken to address those threats. The goal of these summaries is to facilitate and benefit the work of local governments, conservation groups, landowners, and other members of the conservation community who wish to support wildlife conservation within their regions.

Local Action Plan Summaries

In creating the updated Action Plan, the Virginia Department of Game and Inland Fisheries (DGIF) adopted a model developed by the Virginia Department of Conservation and Recreation (DCR) for the Virginia Outdoors Plan. The Virginia Outdoors Plan describes recreational resource issues for 21 multi-county Recreational Planning Regions. Each Recreational Planning Region is roughly analogous to one of Virginia's 21 local Planning District Commissions (PDC). The PDCs are voluntary associations of local governments intended to foster intergovernmental cooperation by bringing together local officials, agency staff, the public, and partners to discuss common needs and develop solutions to regional issues. With its focus on local-scale actions, the Virginia Outdoors Plan has become an important tool for identifying and addressing local recreational issues. This DCR model was adapted and used in this Action Plan to address wildlife and habitat issues for the benefit of planning region residents. More broadly, the new Action Plan's Local Action Plan Summaries will create a framework that Virginia's diverse conservation community can use to identify issues and locations of mutual conservation interest, enhance collaborative opportunities, develop new conservation resources, and craft "win-win" situations that can be beneficial for both the people and wildlife of Virginia.

West Piedmont Planning Region Summary Overview

The West Piedmont Planning Region consists of 1,672,770 acres (2,614 square miles) and includes the counties of Franklin, Henry, Patrick, and Pittsylvania; cities of Martinsville and Danville; and town of Rocky Mount. The human population in this planning region is estimated to be over 245,000 people (U.S. Census Bureau 2015). The planning region is projected to experience some population growth by 2030 (Weldon Cooper Center 2012).

Less developed and more rural areas often provide a diversity of valuable wildlife habitats, which can be degraded or lost as human populations grow or mining and other extractive uses expand. This planning region contains a range of SGCN, including the three species that occur only within this region and nowhere else in the world. They include the margin Madtom, spirit supercoil, and Kosztarab's common stonefly. The planning region also includes a variety of habitats such as spruce fir forests, mixed hardwood and conifer forests, young forests, retired agricultural land, karst, non-tidal wetlands, and warm and cold water streams and riparian habitats (Figure 2).

In developing conservation actions for habitats and priority species within this planning region, a number of factors must be considered to determine how limited resources can be allocated to best effect. A project's likely impact and probability of success, the effectiveness of historic and ongoing conservation actions, as well as logistical, economic, and political factors will all influence the selection and prioritization of conservation actions. Virginia's Wildlife Action Plan advocates a proactive approach that focuses conservation resources to manage species before they become critically imperiled and to implement projects that can simultaneously benefit multiple species and human communities. These factors were considered during development of the conservation actions included in the following sections as well as in analyzing the existing threats facing SGCN and their habitats. Threats and conservation actions are organized based on the habitat types found within this planning region upon which priority SGCN depend.

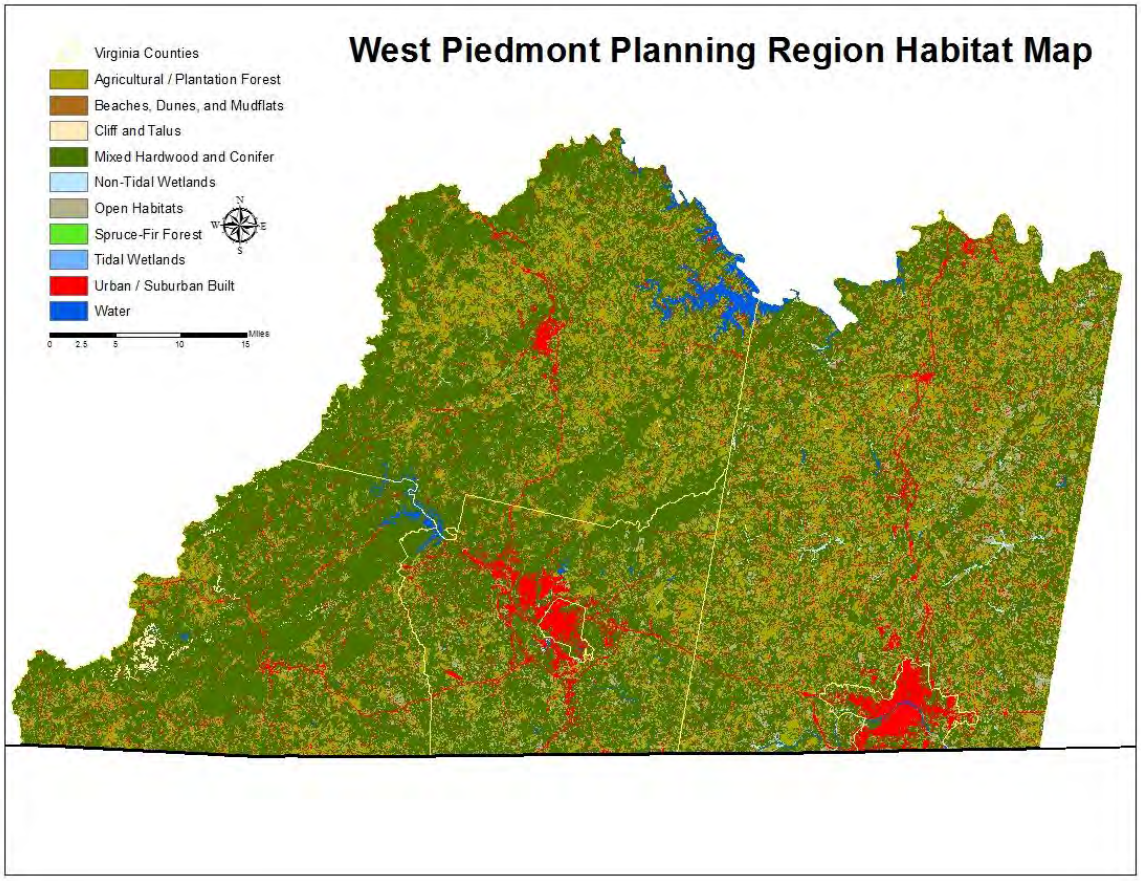

Figure 2. West Piedmont Planning Region Habitats (Anderson et al. 2013).

Priority Species of Greatest Conservation Need

Of Virginia's 883 SGCN, 88 are believed to either occur, or have recently occurred, within the West Piedmont Planning Region (Appendix A). Of these 89 species, ***46 SGCN are dependent upon habitats provided within the West Piedmont Planning Region (Table 2). These species constitute the priority SGCN for the region***. A summary of SGCN Tier and Conservation Opportunity Rankings is provided in Table 1, while Figure 3 demonstrates the density of the 45 priority species within this region.

Priority SGCNs within this Local Summary include species for which this planning region comprises a significant portion of its range in Virginia. To determine species priority, the authors implemented a 10 percent rule to identify locally important species. Under the 10 percent rule, an SGCN is included in a Local Summary if the planning region provides at least 10 percent of that species' range in Virginia. However, there are several other instances that warrant inclusion on a planning region's priority SGCN list. First, several SGCN occur statewide but in low numbers in each planning region and will never reach the 10 percent threshold in any single planning region. Species that fall in this category were manually added to priority SGCN lists where appropriate. Some species only occur in three or fewer planning regions. These SGCN are also included on priority lists for the planning regions in which they are found due to their rarity in

the state and the importance of those few planning regions to their survival. For migrant species that may only be in Virginia for a matter of days, these migratory habitats are considered critical for their long-term conservation. When these circumstances were identified, specific migratory species were manually added to local SGCN lists as well. Finally, where a species may have a particularly strong population in a relatively small portion of a planning region, the population may be determined to be significant enough to warrant inclusion on the local SGCN list. Again, when these circumstances were identified, species were manually added to the local priority SGCN list.

Table 1. Tier and Conservation Opportunity Ranking Distribution among Priority SGCN.

Tier and Conservation Opportunity Rank	Number of SGCN
Ia	1
Ic	3
IIa	2
IIb	2
IIc	1
IIIa	5
IIIb	1
IIIc	5
IVa	11
IVb	5
IVc	10

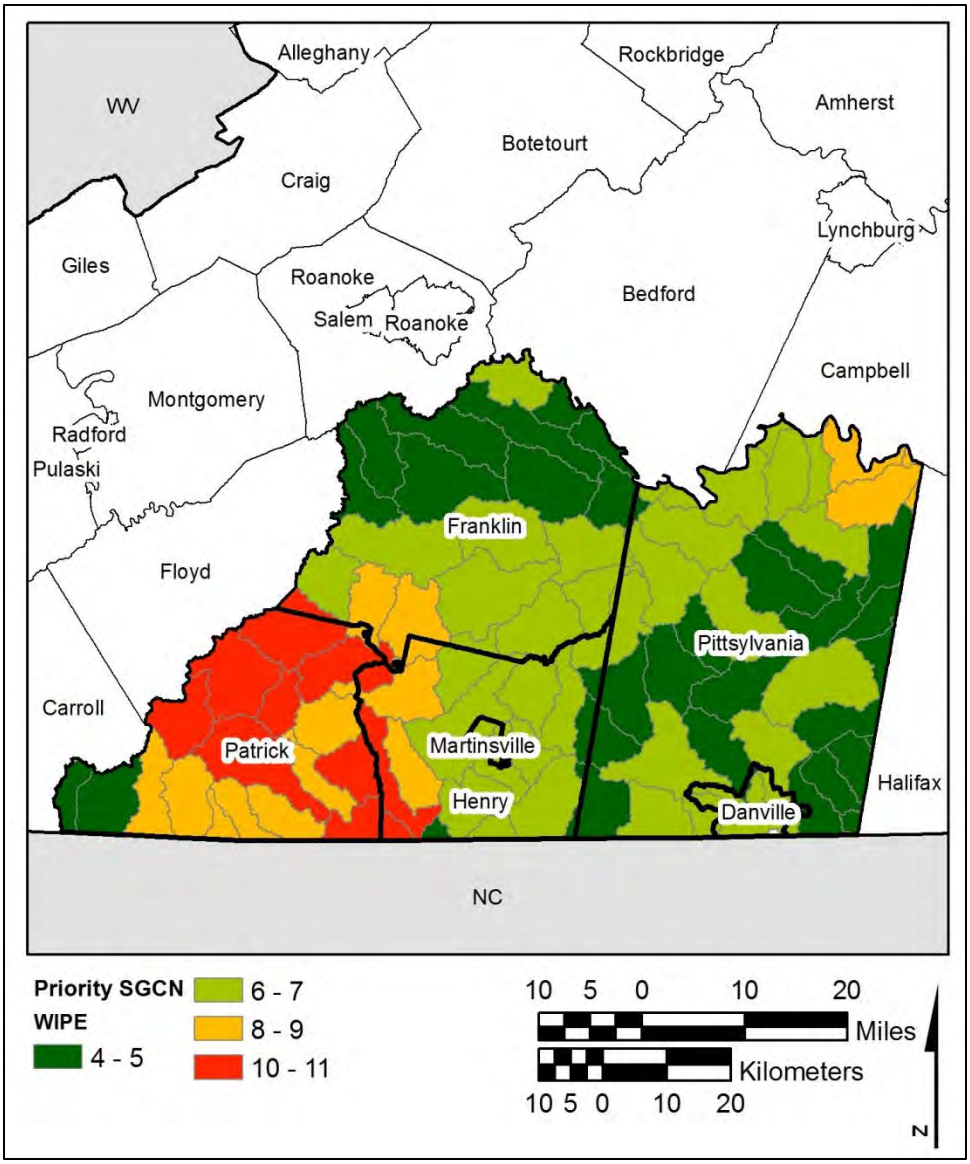

Figure 3. Priority SGCN Density in the West Piedmont Planning Region (HUC12 Watersheds).

Table 2. Priority Species of Greatest Conservation Need Distribution in the West Piedmont Planning Region.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name	Habitat
Amphibian		IV	c	Blue Ridge dusky salamander	Desmognathus orestes	High elevation seeps, streams, wet rock faces, and riparian forests
Amphibian		II	a	Mole salamander	Ambystoma talpoideum	Hardwood and mixed forests containing fish-free breeding ponds
Amphibian		III	a	Shovel-nosed salamander	Desmognathus marmoratus	Cool highly oxygenated high elevation streams with moderate flow and gravel and rock substrates
Amphibian		IV	c	Yonahlossee salamander	Plethodon yonahlossee	Mature hardwood forests with deep leaf litter layer
Bird		III	b	Belted kingfisher	Megaceryle alcyon	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.
Bird		IV	a	Black-and-white warbler	Mniotilta varia	Habitat generalist with broad habitat tolerances
Bird		II	b	Black-billed cuckoo	Coccyzus erythropthalmus	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets
Bird		IV	a	Brown thrasher	Toxostoma rufum	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub
Bird		IV	b	Chimney swift	Chaetura pelagica	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.
Bird		IV	a	Eastern kingbird	Tyrannus tyrannus	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders
Bird		IV	a	Eastern meadowlark	Sturnella magna	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes
Bird		IV	a	Eastern towhee	Pipilo erythrophthalmus	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats
Bird		III	a	Eastern whip-poor-will	Caprimulgus vociferus	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association
Bird		IV	b	Eastern wood-pewee	Contopus virens	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests
Bird		IV	a	Field sparrow	Spizella pusilla	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows

Bird		IV	a	Grasshopper sparrow	Ammodramus savannarum	Grassland obligate
Bird		IV	a	Gray catbird	Dumetella carolinensis	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth
Bird		IV	b	Green heron	Butorides virescens	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons
Bird		III	a	Kentucky warbler	Geothlypis formosa	Humid deciduous forest, dense second growth, swamps
Bird		IV	b	Northern Flicker	Colaptes auratus	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks
Bird		III	a	Ruffed grouse	Bonasa umbellus	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland
Bird		IV	b	Wood thrush	Hylocichla mustelina	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist
Bird		III	a	Yellow-billed cuckoo	Coccyzus americanus	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland
Bird		IV	a	Yellow-breasted chat	Icteria virens	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation.
Fish		IV	c	Appalachia darter	Percina gymnocephala	Clear, cool and warm streams in the New River drainage with upland gradient and gravel substrates
Fish	FS	III	c	Bigeye jumprock	Moxostoma ariommum	Moderate gradient streams with unsilted rubble, boulder, or rock outcrop substrate
Fish		IV	a	Brook trout	*Salvelinus fontinalis*	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes
Fish		IV	c	Highback chub	Hybopsis hypsinotus	Warm water (either clear or turbid) with sandy or rocky bottoms
Fish		III	c	Kanawha darter	Etheostoma kanawhae	Clear creeks and streams with rocky substrates
Fish		III	c	Kanawha minnow	Phenacobius teretulus	Clear moderate gradient streams with clean gravel and rubble substrates
Fish	FSST	II	b	Orangefin madtom	Noturus gilberti	Moderate to strong flows with unsilted substrates
Fish		IV	c	Piedmont darter	Percina crassa	Cool and warm moderate gradient creeks and rivers with clean gravel and rubble substrates
Fish		IV	c	Redlip shiner	Notropis chiliticus	Clear creeks and streams with moderate gradient, warm or cool water and various substrates
Fish		I	a	Roanoke bass	Ambloplites cavifrons	Warm large creeks, streams, and small rivers with low gradient and typically clear water

Fish		IV	c	Roanoke hog sucker	Hypentelium roanokense	Moderate to high gradient streams with rock, gravel, or sand substrates
Fish	FESE	II	a	Roanoke logperch	Percina rex	Warm clear stream and rivers with low to moderate gradient and unsilted substrate
Fish		III	c	Rustyside sucker	Thoburnia hamiltoni	Clean clear streams with moderate to high gradient and unsilted substrates
Fish		III	c	Snail bullhead	Ameiurus brunneus	Well flowing streams and rivers with rocky substrates
Fish		IV	c	Speckled killifish	Fundulus rathbuni	Slow moving streams and creeks with sandy substrates
FW Mollusk		IV	c	Gravel elimia	Elimia catenaria	Streams and rivers with high ground water content and good flow
Insect	FS	I	c	Kosztarab's common stonefly	Acroneuria kosztarabi	Unknown but stoneflies generally occur in fast flowing water with rocky substrates
Insect		II	c	Pygmy snaketail	Ophiogomphus howei	Large fast flowing rivers
Other Terrestrial Invertebrate	FSST	I	c	Laurel Creek xystodesmid millipede	Sigmoria whiteheadi	Known from one location where it occurs under leaf litter of rhododendrons and hardwoods within 5 meters of stream
Other Terrestrial Invertebrate	FSSE	I	c	Spirit supercoil	Paravitrea hera	Site specific - inhabits leaf litter on specific river bluffs in Pittsylvania county
Reptile		IV	c	Southeastern crowned snake	Tantilla coronata	Forest generalist but require soils suitable for digging
Reptile	CC	IV	a	Timber rattlesnake	Crotalus horridus (timber)	Barren

** Federal Endangered (FE), State Endangered (SE), Federal Threatened (FT), State Threatened (ST), Federal Species of Concern (FS), Federal Candidate (FC), Federal Species of Concern (FS), and Species of Collection Concern (CC).

Conserved Lands in the West Piedmont Planning Region

Recognizing the importance of the local habitats to resident and migratory wildlife, state, federal, and private entities have made significant investments to conserve lands within this planning region. Conservation mechanisms range from national parks and monuments to state wildlife management areas and parks to conservation easements. Significant conservation assets, in terms of size, include:

- Blue Ridge Parkway National Park,
- Booker T. Washington National Monument,
- Whiteoak Mountain Wildlife Management Area,
- Turkeycock Mountain Wildlife Management Area,
- Fairystone Farms Wildlife Management Area,
- Fairy Stone State Park,
- Mayo River State Park,
- Grassy Hill State Natural Area Preserve, and
- Philpott Reservoir.

These properties contain a diversity of open water, forest, agricultural, and wetland habitats (Figure 4). They have been conserved to provide a range of conservation, recreational, and economic benefits such as habitat protection and restoration, ecotourism, and fishing and hunting opportunities.

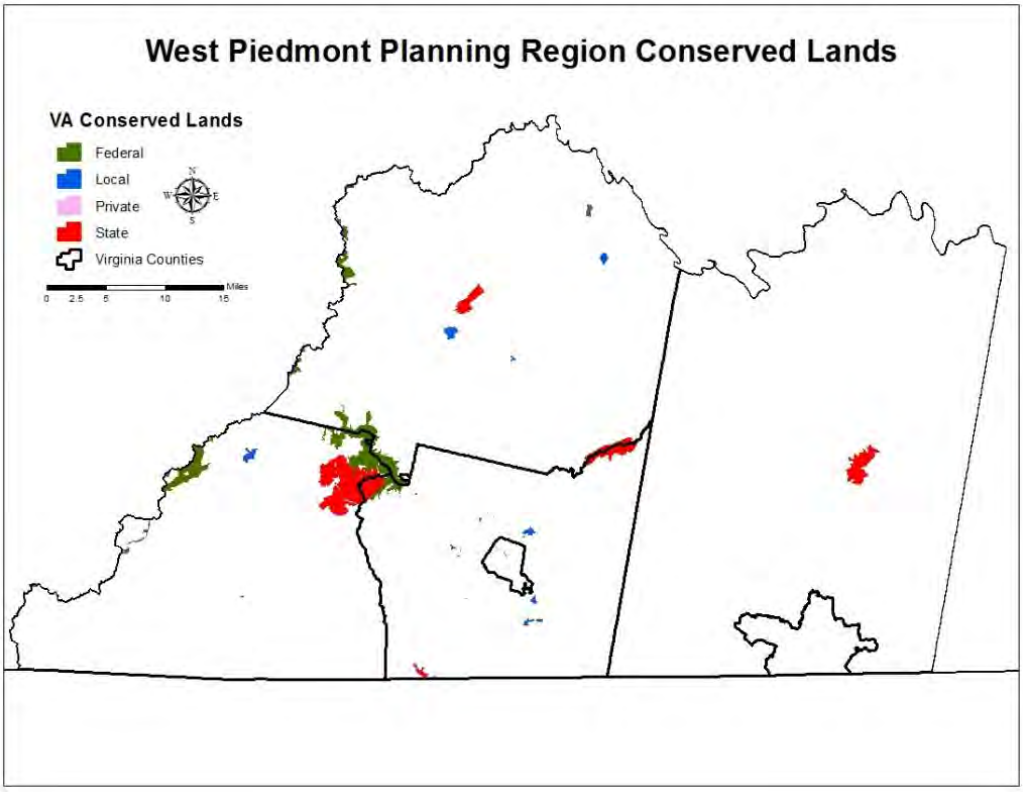

Figure 2. Conservation Lands in the West Piedmont Planning Region (DCR, Natural Heritage 2014).

These properties serve as an important component of wildlife conservation efforts on within West Piedmont Planning Region. Healthy and important habitats have been conserved within their boundaries; however, working to conserve other lands could be beneficial for many SGCN and habitats within the region. There may be concern over the economic and social impacts of putting more lands into conservation, but many of these areas provide recreation and ecotourism benefits (DCR 2013a; Carver and Caudill 2013). Through these mechanisms local economies could be bolstered; however, insufficient data exist to fully describe the benefits and drawbacks of lands held in conservation within the planning region. To balance these interests, especially as conditions change, it will be critical for the conservation community to actively engage with local governments and stakeholders to ensure that conservation spending is beneficial for both wildlife and localities.

Climate Change Impacts in the West Piedmont Planning Region

Changes in temperature and precipitation will also likely negatively affect habitats and SCGN in the West Piedmont Planning Region. Based on scientific reports and research, it is clear that temperatures in the state will get warmer. The National Climate Assessment (NCA) is a national climate assessment that provides state level information. The NCA indicates Virginia's average temperature could increase by as much as 7°F by 2100 (Melilo et al. 2014). Earlier models used for Virginia's 2008 Climate Action Plan project that average temperatures may increase by 3.1°C (5.6°F) by the end of the century in Virginia (Governor's Commission on Climate Change 2008).

Increased temperatures may lead to heat stress for species and affect water temperature, temperature regime timing, and associated behaviors as well as potentially resulting in changes to food availability (Boicourt and Johnson 2011; Kane 2013). Temperature increases may also be problematic for species at the edge of their ranges. For example, if species are at the more southern end of their range, they may not survive significant increases in temperature that are greater than they can withstand (Pyke et al. 2008). Warmer temperatures may also result in warmer waters, which could favor parasites and other pests in aquatic environments (Pyke et al. 2008; Najjar et al. 2010; Kane 2013). Additionally, if temperatures and precipitation change such that season length is altered, fish and other species reproductive cycles and other phenological processes may be affected. Ecological conditions may also be altered, including food supplies and sympatric animal behaviors (e.g., fish migrations and nest building).

Conservation Threats and Actions for Wildlife and Habitats in the West Piedmont Planning Region

The following sections on threats, conservation actions, and conservation priorities are subdivided based on habitat type. Key habitat conservation strategies, actions, threats, and other impacts are summarized in Table 3. In many cases, actions taken to protect or enhance habitat will positively affect many West Piedmont Planning Region priority SGCN and other species. Many of these activities are also expected to benefit landowners and communities.

Table 1. Summary of Conservation Strategies and Actions for West Piedmont Planning Region.

Conservation Strategy	Conservation Action	Threats Addressed	Economic/ Human Benefits	Priority Areas
Enhance, maintain, and restore aquatic and riparian habitats	1) Establish vegetated riparian buffers along streams in agricultural areas and in residential areas and incorporating riparian buffers into land use planning and management; 2) Reforest erodible pasture and croplands; 3) Improve management of pastures to prevent manure-tainted runoff from flowing into streams, improve methods for incorporating manure into soil and/ or create additional waste storage units, and implement rotational grazing systems; 4) Exclude livestock from streams and providing alternative water sources;5) Repair or replace failing septic systems and "straight pipes;" 6) Establish a pet waste program to reduce bacterial inputs from pets; 7) Continue to identify impaired water within the planning region; 8) Restore aquatic connections; 9) Monitor and address invasive species impacts; and 10) Adopt land use practices or policies through zoning or other means to help improve the health of aquatic systems.	Sedimentation, contaminants loading, water chemistry alteration, temperature regime alteration, stream nutrient dynamics alteration, land use changes, water withdrawals, climate change, invasive species	Address TMDL concerns by reducing amounts of sediment, nutrients, pesticides, and other pollutants that enter water ways; sustain sport fisheries and recreation opportunities; contribute to clean water supply	Banister River, Sandy Creek, Bearskin Creek, Cherrystone Creek, Stinking River, Upper Banister River, Whitethorn Creek, Blackberry Creek, Leatherwood Creek, Marrowbone Creek, Mayo River Tributaries, Smith River, Gills Creek, Lower Blackwater River, Maggodee Creek, Old Womans Creek, Pigg River, Upper Blackwater River
Maintain and restore forest habitat	1) Protect land through acquisition, easement, incentives, or other mechanisms; 2) Implement vegetative buffers around extractive practices and development; 3) Work with state and federal agencies to ensure implementation of appropriate best management practices; 4) Maintain forest health to help ensure forest viability; and 5) Monitor and control invasive species.	Land use change and conversion, invasive species, climate change	Flood control; water quality; ecotourism/ wildlife viewing/other outdoor recreation	Forest patches adjacent to already protected parcels

Maintain and restore open habitats	1) Restore native grasses, shrubs, and forbs; 2) Maintain existing open habitats with periodic disturbance (e.g., prescribed burning, mowing, disking, etc.); and 3) Conserve, via acquisition, easement, collaboration, or agreement, patches from 20 acres to 100 or more acres.	Land use changes, invasive species	Conservation of native pollinators; erosion control; sequestration of nutrients, pesticides, and other pollutants before they enter river systems	Areas supporting SGCN that are not already protected

Enhance, Maintain, and Restore Aquatic and Riparian Habitats

Aquatic systems in the West Piedmont Planning Region include cold and warm water rivers, streams, and creeks. The primary river systems are the Roanoke, Dan, Mayo, and Blackwater Rivers. Approximately 24,600 acres (1.5 percent) of the planning region are considered aquatic (Anderson et al. 2013). These systems provide important habitat for numerous species of wildlife, fish, and invertebrates. Priority SGCN that depend on these habitats include many invertebrate and fish species, such as the brook trout, spotted-margin madtom, rustyside sucker, riverweed darter, orangefin madtom, highback chub, Roanoke hog sucker, and snail bullhead.

Threats

Aquatic and riparian habitats within the West Piedmont Planning Region face multiple threats from water quality related issues to invasive species.

1. Water Quality Degradation: Pollution is the most significant threat to aquatic species and riparian habitats within the West Piedmont Planning Region. Polluting materials include fertilizers, eroded sediment, and human and animal waste flowing into the region's creeks and rivers from storm water runoff, failing septic systems, and agricultural practices that do not conform to standard best management practices (DEQ 2014). In many cases, watersheds have insufficient riparian buffers and vegetative areas to stop these materials from flowing into the creek or stream (ACJV 2005). Once present in aquatic systems, these materials may concentrate in sediment and bottom-dwelling organisms where they can result in reduced levels of dissolved oxygen and altered pH levels (Chesapeake Bay Foundation 2014). In addition to the impacts on aquatic life, many of these substances pose a risk to human health and local economies (Chesapeake Bay Foundation 2014).

2. Impervious Surface: Impervious surfaces (i.e., land covers that do not permit water to permeate the ground) give a useful measure of the environmental condition of an area. In a developed watershed there is often significant impervious surface cover; thus, a greater amount of surface water, often laden with pollutants, arrives into a stream at a faster rate than in less developed watersheds, increasing the likelihood of more frequent and severe flooding. Substantial amounts of impervious surface area can also lead to degradation of water quality, changes in hydrology, habitat structure, and aquatic biodiversity. Additionally, impervious surfaces often run along areas that directly interact with the stream or river through flooding, geomorphology, or material inputs. Although West Piedmont Planning Region has watersheds with a high percentage of impervious surface cover around the major cities, the majority of the planning region has a low percentage of impervious surface cover (Figure 5).

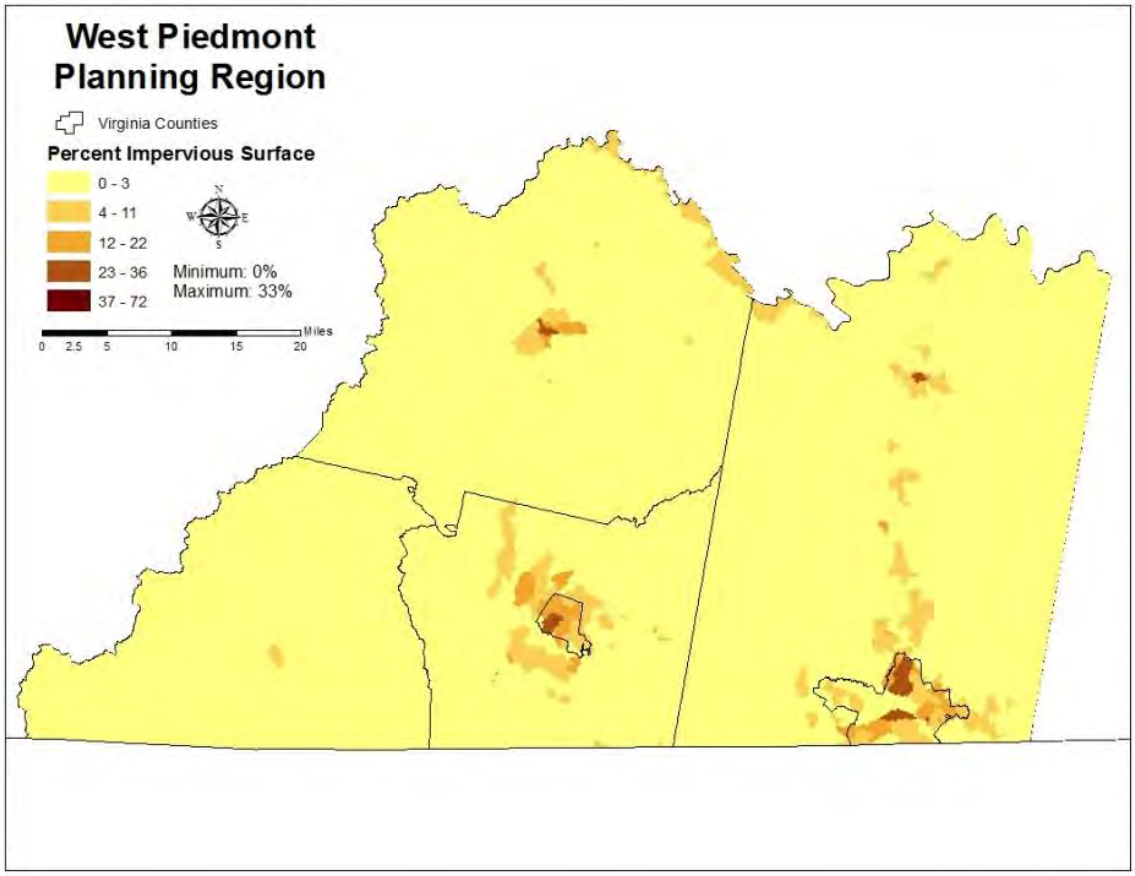

Figure 5. Impervious Surface Cover in West Piedmont Planning Region (SARP 2014).

3. Habitat Conversion and Alteration: Rivers are fragmented by dams, culverts, and other impediments that limit the connectivity of these aquatic habitats. This fragmentation can prevent aquatic species from accessing important aquatic habitats crucial to various life stages. Channelization, shoreline alteration, and extractive land use practices can alter aquatic habitats in terms of changes to hydrology, chemistry, and water temperature. These practices may also directly alter habitats through loss of vegetative riparian cover, filling of streams, or hardening of stream banks.

4. Invasive Species: Invasive species such as white perch threaten western warm water streams and rivers. Invasive species are less of a direct threat to fish within cold water systems, but invasive species cause significant impacts to the forests surrounding these systems. Defoliation by the emerald ash borer, gypsy moth, hemlock woody adelgid, and southern pine beetle can alter river and stream hydrology and temperature, especially important to cold water streams.

5. Climate Change: Climate change will also affect both warm and cold water streams. Changes to precipitation regimes and temperatures will result in changes to flow patterns, erosion rates, and water temperatures.

Conservation Management Actions

Water Quality Improvement Plans have been developed by the Virginia Department of Environmental Quality (DEQ) and various partners. Watersheds within the planning region that have Water Quality Improvement Plans include: Banister River and Sandy Creek (Blue Ridge Environmental Solutions 2012); Bearskin Creek, Cherrystone Creek, Stinking River, Upper Banister River, and Whitethorn Creek (MapTech 2011); Blackberry Creek, Leatherwood Creek, Marrowbone Creek, Mayo River Tributaries, and Smith River (George Washington University and The Louis Berger Group 2013); Gills Creek, Lower Blackwater River, and Maggodee Creek (DCR 2006); Old Womans Creek and Pigg River (Pigg River IP Steering Committee 2009); and Upper Blackwater River (MapTech 2001) (Figure 6).

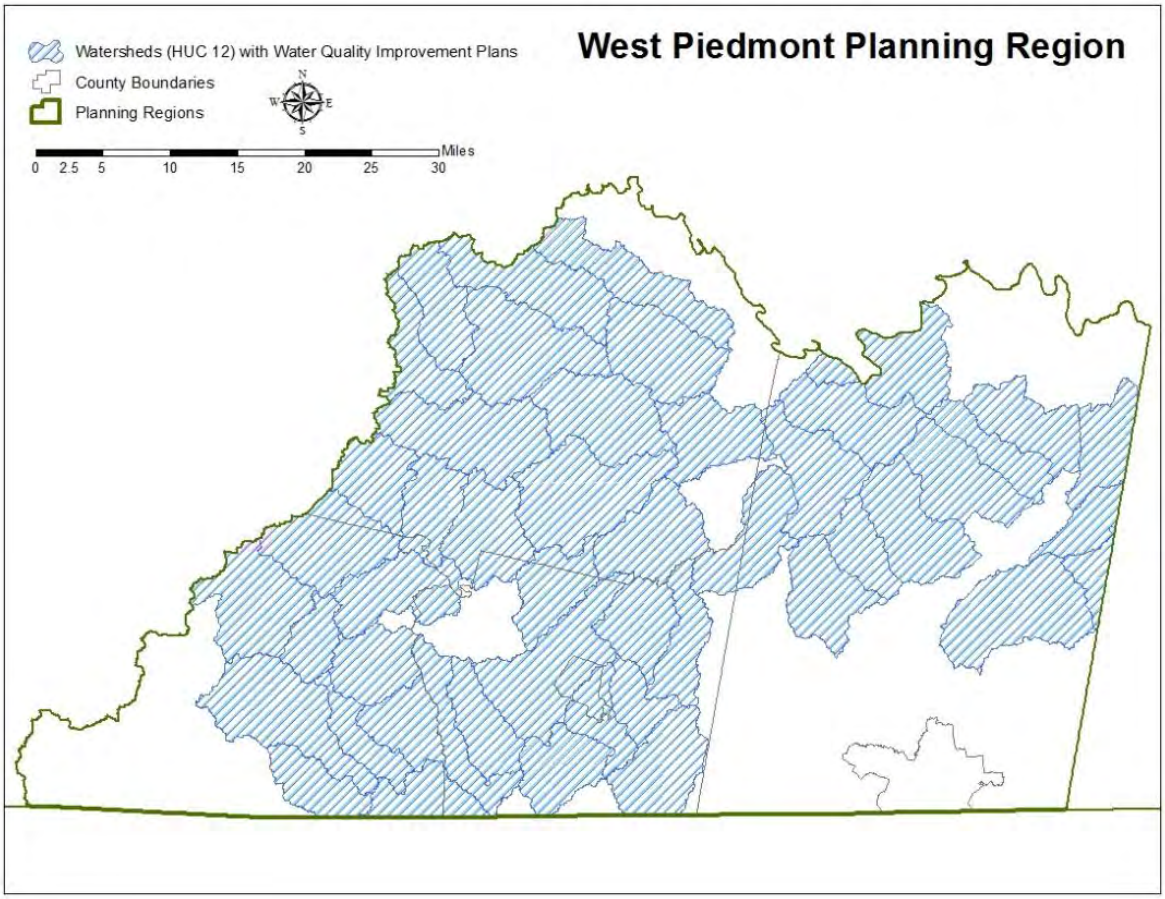

Figure 6. Watersheds with Water Quality Improvement Plans.

These watersheds are designated as being impaired, and the primary actions needed to improve water quality within these watersheds include:

- Establishing vegetated riparian buffers along streams in agricultural areas and in residential areas and incorporating riparian buffers into land use planning and management;

- Reforesting erodible pasture and croplands;
- Improving management of pastures to prevent manure-tainted runoff from flowing into streams, improving methods for incorporating manure into soil and/ or creating additional waste storage units, and implementing rotational grazing systems;
- Excluding livestock from streams and providing alternative water sources;
- Repairing or replacing failing septic systems and “straight pipes” depositing human waste into streams; and
- Establishing a pet waste program to reduce bacterial inputs from pets.

Members of Virginia’s conservation community may consider working in other watersheds of local significance that may not have a Water Quality Improvement Plan. The Virginia Watershed Integrity Model identifies high value watersheds within the planning region for conservation based on their proximity to headwater streams, drinking water source protection, and biological integrity indices (Ciminelli and Scrivani 2007). These areas provide a starting point for identifying additional areas to focus conservation efforts (Figure 7).

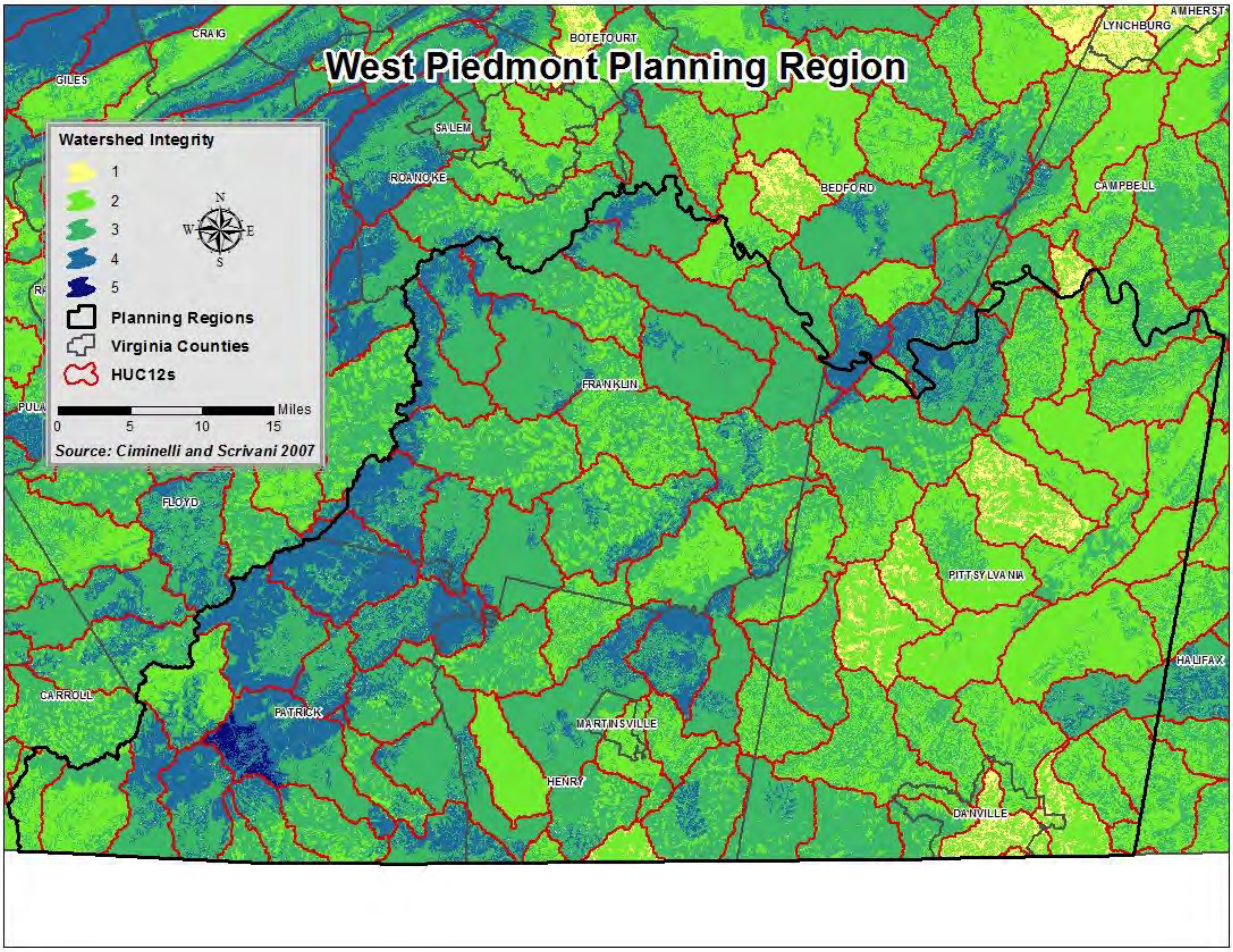

Figure 7. Watershed Integrity Model for West Piedmont Planning Region (Ciminelli and Scrivani 2007).

Several conservation actions common to most water quality and instream habitat enhancement plans can be implemented with little chance of ill consequence to wildlife or human communities downstream in these areas. Some of the most beneficial actions would include:

- Working with landowners to exclude livestock from streams;
- Reducing impervious surface by replacing with more porous materials or vegetation;
- Restoring or enhancing vegetated riparian buffers; and
- Working to enhance the health of upland forests and grassland habitats.

Additionally, many agencies help landowners in the West Piedmont Planning Region establish vegetative buffers along waterways flowing through their properties. The Virginia Department of Forestry (DOF), Virginia Department of Agriculture and Consumer Services (VDACS), and DCR have established best management practices (BMPs) for various land uses, which if implemented serve to minimize land use impacts upon adjacent and downstream waters. In addition, landowners are encouraged to work with DOF through the Forest Stewardship Program to utilize timber production BMPs, such as implementation of buffers and careful planning of roads and stream crossings, and agricultural producers are encouraged to work with VDACS and the local Soil and Water Conservation Districts to control erosion and limit runoff through the various available programs (DOF 2014; DCR 2014). The Natural Resources Conservation Service (NRCS) provides landowners with other opportunities, including the Environmental Quality Incentives Program.

Stream restoration and connectivity projects (e.g., removing dams and culverts or modifying them to allow for passage) help improve and provide additional aquatic habitats for fish species within the state; however, there are many dams, and not all can or should be removed. Priority watersheds that would benefit from enhanced connectivity have been identified by the Chesapeake Bay Fish Prioritization Tool and the Southeast Aquatic Connectivity Assessment Tool (Figure 8) (Martin and Apse 2013).

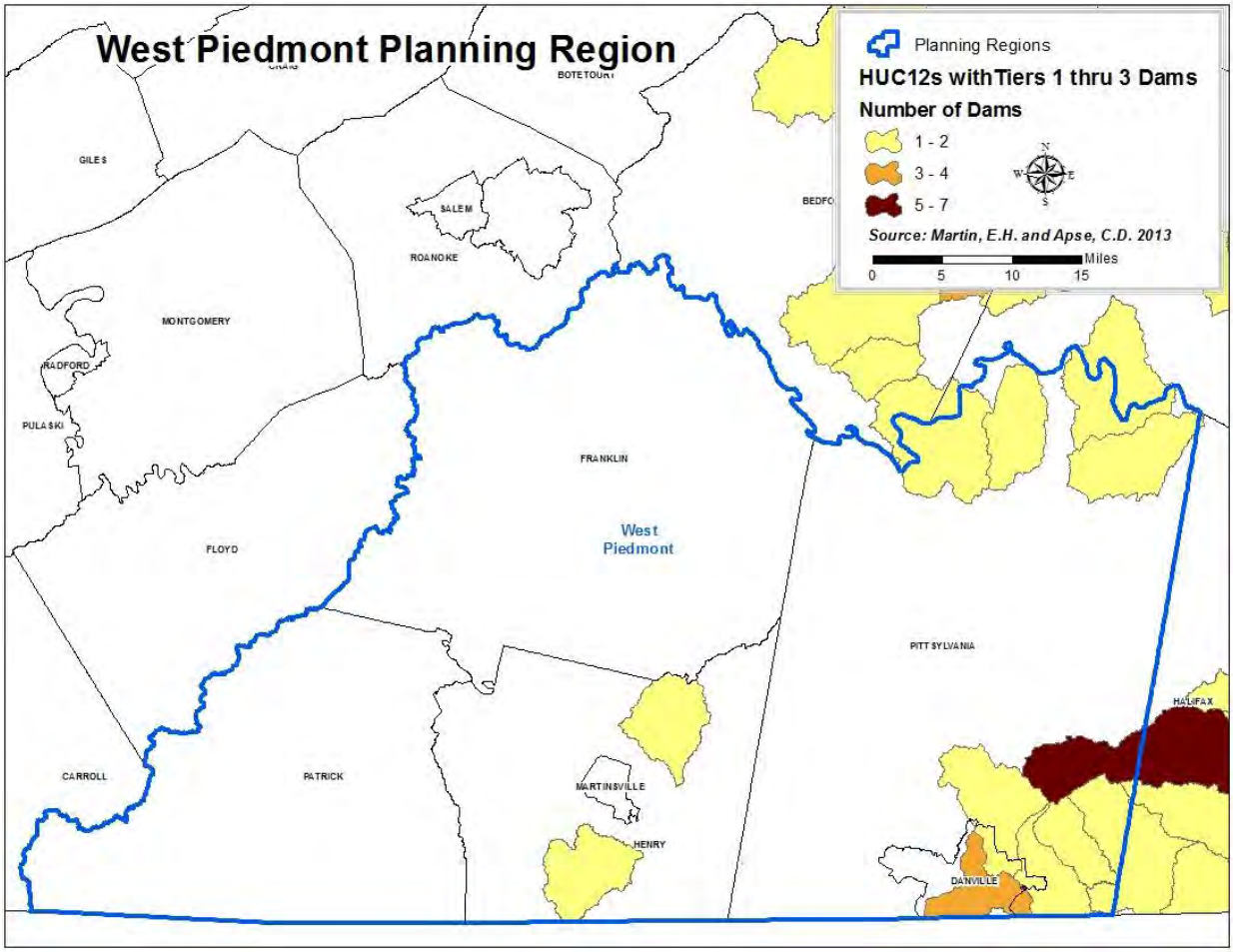

Figure 8. HUC12 Watersheds with Priority Dams for Removal/ Modification for Enhanced Connectivity (Martin and Apse 2013).

Additional actions to improve aquatic systems in the West Piedmont Planning Region include monitoring and addressing invasive species impacts and working with the planning region to adopt use practices or policies through zoning or other guidelines (e.g., impervious surface limits) to help improve the health of aquatic systems within and downstream of regions that have significant impervious surface areas. Additionally, land acquisitions or easements that will help protect the land surrounding creeks should also be considered.

Climate-Smart Management Actions

When planting, restoring, or maintaining riparian buffers, managers should consider how conditions may change in the area and work with appropriate vegetation. For example, if stream flow is expected to become erratic due to increased precipitation or more frequent flooding as is projected to occur, native tree and shrub species that can tolerate flood conditions and inundation should be included in the selected plant species. Utilizing native species that may provide better erosion control (broader, deeper roots) than other species should be encouraged. Techniques and tools may be needed (e.g., fencing, biomats, etc.) to ensure success. Additionally, as stream temperatures will likely increase and hydrologic regimes may shift, it will be important to focus on maintaining and/ or improving stream

connectivity to ensure aquatic organism can move to preferred habitats as these conditions change. Minimizing impervious surface will be even more important under climate change as increased storm intensity will likely result in increased levels of stormwater runoff. Improving stormwater control methods, to ensure they account for predicted changes in precipitation and flow, could help minimize the future impacts of storm water under climate change (Kane 2013).

Conserve and Manage Forest Habitats

Mixed hardwood and conifer forests make up over half of the West Piedmont Planning Region and are important for a broad range of species (Table 4). Young forest habitats are loosely defined as areas dominated by woody seedlings and saplings (Oehler et al. 2006). Previously, young forests were often referred to as an early successional habitat for eastern portions of North America. The young forest component (age class) in most of the forests within the planning region is lacking, which will impact the tree species present within these forests in the future. Lack of young forest habitat has detrimental effects on the wildlife species that depend on this forest stage for survival. These mixed hardwood and conifer forests help protect water resources within the region and provide habitat for species such as the Eastern wood-pewee, wood thrush, spirit supercoil, Southeastern crowned snake, and Blue Ridge dusky salamander, among other species.

Table 4. Forest Acreage Totals in the West Piedmont Planning Region (Anderson et al. 2013).

Forest Type	Acreage	Percent of Planning Region
Mixed Hardwood and Conifer	1,020,982.43	61.04%

Threats

Forests within this planning region face a range of threats.

1. Land Use Changes and Conversion: The largest threat to spruce fir and mixed hardwood and conifer forests within the West Piedmont Planning Region is fragmentation, mainly due to expanding residential and commercial development and resulting roads. In many cases, the losses can be complete and have profound impacts on local wildlife species composition, water quality, and outdoor recreational opportunities. If established BMPs are followed, impacts to waterways and adjoining properties can be prevented or mitigated such as through implementation of vegetative buffer areas (see below). Energy development and other extractive uses could also degrade habitat and affect species composition and water quality.

2. Invasive Species: Invasive plant species and pests are also a significant problem for forests in this region.

3. Climate Change: More intense storm events, higher temperatures, and the potential for droughts may exacerbate existing stressors as well as damage intact forests and result in more forest fires and an increase in incidence of pests.

Conservation Management Actions

Actions for conserving mixed hardwood and conifer forests in the West Piedmont Planning Region may include working to conserve, either through acquisition, easement, cooperative management, or incentives, intact forest patches capable of supporting a variety of Action Plan species. Land protection will help reduce conversion of forests to development.

Working with landowners to ensure BMPs such as vegetative buffers are in place around agricultural or timber harvest areas will help prevent erosion and run off of sediments and nutrients into adjacent streams. Research demonstrates that vegetative riparian buffers can filter significant amounts of nutrient run off from timber operations and agricultural fields (DOF 2014). Some BMPs recommend a 50 foot buffer and allow some timber harvest within the buffers, while other BMPs encourage a 100 foot buffer with no harvest (DOF 2014; A. Ewing, Virginia Department of Game and Inland Fisheries, personal communication, 2015). BMPs also recommend building roads on areas with minimum slope and minimizing or avoiding stream crossings (DOF 2014). The *Plan to Reduce Bacteria Sources in the Upper Banister River and Tributary Watersheds* developed by DCR and stakeholders specifically highlights reforesting areas around eroding crop lands and pastures within the Bearskin Creek, Cherrystone Creek, Stinking River, Upper Banister River, and Whitethorn Creek watersheds to help decrease sediment run off as well as provide wildlife habitat (MapTech 2011). Similar actions are recommended for the Blackberry Creek, Leatherwood Creek, Marrowbone Creek, Mayo River Tributaries, Smith River, Old Womans Creek, and Pigg River watersheds (George Mason University and The Louis Berger Group 2008; Pigg River IP Steering Committee 2009).

Working to maintain forest health (balance age classes and diversity of tree species) is also integral to ensuring forest habitat is available to be conserved and protected. DOF makes several key recommendations that relate to habitat health, including but not limited to using species within their native ranges, if feasible using a mix of tree species to help minimize susceptibility to pests, preventing unnecessary site disturbance, and protecting unusual (rare) forest habitats (DOF 2014). In terms of invasive species and pests, monitoring and control will be important to prevent its spread. Some of these forest habitats should be managed with thinning and prescribed burns to minimize outbreaks (Brooks and Lusk 2008; DOF 2014).

Climate-Smart Management Actions

To best manage forests in the West Piedmont Planning Region as the climate changes, it will be imperative to understand how climate may affect potential future composition of forests in Virginia and how that may affect SCGN. Conservation and management efforts may need to focus on trees that can better withstand increased temperatures and drought, among other impacts. Providing forest habitat at elevation gradients for species migration also will be an important factor for enhancing resilience to climate change. Managers may wish to consult the U.S. Forest Service's tree atlas when planning management and conservation of these forests. Additionally, harvest guidelines may need to be revised, depending on projections for future tree composition. Invasive species monitoring and prevention will also become even more important to include in forest management as climate change may favor some tree pests, diseases, and invasive species.

In terms of considering how to best manage for birds, mammals, and other species that depend on these forests, managers will want to try to provide refugia for SGCN as habitat is lost as well as

establishing corridors both north/ south and east/west between protected areas to assist with species movements as conditions change (King and Finch 2013). Some SGCN will not be able to migrate without contiguous forests, so some species may still be lost, but implementing conservation management actions and developing corridors can help provide can them the best chance at continued existence. It will also be important to work to maintain species diversity and continue to reduce existing stressors that will likely exacerbate impacts from climate change (McKelvey et al. 2013).

Maintain and Restore Open Habitats

Open habitats represent an assortment of habitat types that are botanically characterized by grasses, forbs, and shrubs. Trees may be present, but they tend to be widely spaced and crowns do not form a canopy. DGIF biologists and partners have indicated several varieties of open habitats are important for Action Plan species. Open habitats are often comprised of post-agricultural lands, savannas, barrens, and glades and make up approximately 32,000 acres (2.3 percent) of the planning region (Anderson et al. 2013). These habitats are becoming rare in Virginia as agriculture and timber harvest practices change; however, they are important to a range of species that depend on these areas for nesting, feeding, and protection. Although a small portion of this planning region (less than three percent), these habitats are important for priority SGCN, including the tawny crescent and Persius duskywing butterfly.

Threats

Changing land use patterns has played a large role in the loss of open habitats as has alteration to natural disturbance regimes.

1. Land Use Changes: Dozens of open habitat species have been affected by changing land use and agricultural practices that resulted in either degraded or destroyed open habitats. The most serious threats to remaining open habitats within the planning region involve either development (where habitats are converted for human use) or natural succession (where trees are allowed to dominate and the site eventually becomes forest).

2. Invasive Species: Invasive species are also problematic, especially tree of heaven, Japanese stilt grass, garlic mustard, and privet. These species can out-compete native open habitat species and take over the landscape. Some species such as tree of heaven can change the landscape from an open habitat to a more closed habitat relatively quickly due to its ability to spread and colonize areas rapidly (VISWG 2012). Japanese stilt grass also grows quickly and in mats that can crowd out native grasses. It also alters soil pH inhibiting growth of other native plants (VISWG 2012).

Conservation Management Actions

Specific management practices could include the removal of non-native grasses, encouraging the growth of native warm-season grasses, shrubs and forbs, and periodic disturbance (e.g., burning, mowing, disking, etc.) to maintain the early successional communities and prevent the growth of forest trees (DGIF 2015). Opportunities also exist with forest managers. Silviculture creates young forest conditions that can be managed to provide open habitat opportunities for the first 10 to 15 years after harvest

(WMI 2014). Additional actions include working to protect open land patches at a minimum of 20 acres (Wolter et al. 2008). Focus also should be placed on protecting circular or square patches rather than rectangular areas to minimize edge effect (Wolter et al. 2008). The NRCS provides landowners with opportunities to improve or restore open habitats via programs like the Conservation Reserve Program and the Environmental Quality Incentive Program.

Climate-Smart Management Actions

Changes in temperature and precipitation regimes could negatively affect open lands as temperatures increase and summers become drier and more prone to drought. However, research demonstrates that many species that make up open habitats are already relatively drought tolerant, meaning that open lands may not be as affected by climate change as other habitats if they can maintain their diverse make up of vegetation species (Craine et al. 2013). It is important to note that if there is extended severe drought, open lands may succumb over time (Craine et al. 2013). To maintain diversity and help build resiliency in open lands within this planning region, it will be important to implement the management options above, especially focusing on removing non-natives and ensuring a diverse mix of vegetation species. Additionally, working to protect and preserve larger tracts of grasslands will help provide refugia for the species that depend on this habitat.

Effectiveness Measures Examples

As discussed within the Action Plan's Introduction (see Measuring the Effectiveness of Conservation Actions), it is increasingly important for the conservation community to demonstrate the effectiveness of conservation actions. Elected officials, budget authorities, private donors, and members of the public want to know that their investments in wildlife conservation are having the desired effects. During 2011, the Association of Fish and Wildlife Agencies developed and tested a series of effectiveness measures meant to support the Wildlife Action Plan implementation and the State Wildlife Grants program (AFWA 2011).

Virginia's 2015 Wildlife Action Plan describes a diversity of conservation actions that should help keep species from becoming endangered. The majority of these involve habitat protection, habitat restoration, controlling invasive species, or implementing efforts to keep pollutants from flowing into Virginia's waterways. Important data that can demonstrate the effectiveness of these conservation actions can include the following:

Conservation Action	Indicators of Effectiveness
Creation of Vegetative/ Forest Buffers along Streams or Wetlands	• Before/ after photos of project site; • Photos documenting changes as vegetation matures over multiple years; • Before/ after measurements of sedimentation immediately downstream of site; and • Changes in the number and diversity of species utilizing the site.
Control of Invasive Plants	• Before/ after photos of project site; • Photos documenting changes as restored vegetation

	matures over multiple years; and • Before/ after comparison of the number and diversity of species utilizing the site.
Remove Cattle from Streams	• Before/ after photos of project site; • Photos of alternative watering systems (if appropriate) • Photos documenting changes in shoreline as restored vegetation matures over multiple years; • Before/ after comparison of sediment and water chemistry immediately downstream of site; and • Before/ after comparison of the number and diversity of species utilizing the site.
Creating or Improving Open Habitats	• Before/after photos of project site; • Photos documenting changes to the site as the vegetation matures; and • Before/ after comparison of the number and diversity of species utilizing the site.

CONCLUSION

The development of the Virginia Wildlife Action Plan presented a unique opportunity for the Commonwealth—an opportunity not only to assess the condition and status of the state's wildlife and habitat resources, but to provide a shared vision and purpose in the management and conservation of this "common wealth." The true value of this initiative is this recognition of common interests and the enhancement of existing and fostering of new partnerships to address issues of mutual concern. The Action Plan's long-term success will depend on the implementation of the recommended actions by partners across the state and the effectiveness with which conservation partners collectively manage these natural resources.

This Local Action Plan Summary aims to prioritize species, habitats, and conservation actions within this planning region, so that partners working within this region can use limited resources to greatest effect. However, Virginia faces serious issues. Not addressing these problems would risk more species becoming threatened or endangered, the quality of our land and water would decline, and Virginians could lose important pieces of our natural heritage that contribute to our quality of life. However, there are significant conservation opportunities to benefit wildlife and people in the planning region. Our problems are not insurmountable, and most can be addressed with proven conservation management techniques.

Working to maintain and protect existing high quality habitat will be a priority before restoration; however, restoration is still an important action and necessary in many cases. Within the West Piedmont Planning Region, priority conservation opportunities include:

- Protecting the quantity and quality of water.
- Maintain and conserve patches of mixed hardwood and conifer forests.
- Working to restore and improve open habitats.

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APPENDIX A. COMPLETE LIST OF SPECIES OF GREATEST CONSERVATION NEED IN WEST PIEDMONT PLANNING REGION

Complete SGCN list for the West Piedmont Planning Region (SGCN=88). Table includes federal and state statuses, Wildlife Action Plan Tier, and Conservation Opportunity Rankings. Species are listed in alphabetical order by taxa.

Taxa	Conservation Status	Tier	Opportunity Ranking	Common Name	Scientific Name
Amphibian		IV	a	Blue Ridge dusky salamander	*Desmognathus orestes*
Amphibian	**CC**	I	a	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*
Amphibian		IV	a	Eastern mud salamander	*Pseudotriton montanus montanus*
Amphibian		IV	c	Eastern spadefoot	*Scaphiopus holbrookii*
Amphibian		II	a	Mole salamander	*Ambystoma talpoideum*
Amphibian		III	a	Shovel-nosed salamander	*Desmognathus marmoratus*
Amphibian		IV	c	Yonahlossee salamander	*Plethodon yonahlossee*
Bird		II	a	American black duck	*Anas rubripes*
Bird		II	a	American woodcock	*Scolopax minor*
Bird		III	a	Barn owl	*Tyto alba*
Bird		III	b	Belted kingfisher	*Megaceryle lcyon*
Bird		IV	a	Black-and-white warbler	*Mniotilta varia*
Bird		II	b	Black-billed cuckoo	*Coccyzus erythropthalmus*
Bird		IV	a	Brown thrasher	*Toxostoma rufum*
Bird		IV	b	Chimney swift	*Chaetura pelagica*
Bird		II	a	Common tern	*Sterna hirundo*
Bird		IV	a	Eastern kingbird	*Tyrannus tyrannus*
Bird		IV	a	Eastern meadowlark	*Sturnella magna*
Bird		IV	a	Eastern towhee	*Pipilo erythrophthalmus*
Bird		III	a	Eastern Whip-poor-will	*Caprimulgus vociferus*
Bird		IV	b	Eastern wood-pewee	*Contopus virens*
Bird		IV	a	Field sparrow	*Spizella pusilla*
Bird		III	a	Forster's tern	*Sterna forsteri*
Bird		IV	a	Grasshopper sparrow	*Ammodramus savannarum*
Bird		IV	a	Gray catbird	*Dumetella carolinensis*
Bird		IV	a	Greater scaup	*Aythya marila*
Bird		IV	b	Green heron	*Butorides virescens*
Bird		III	a	Kentucky warbler	*Oporornis formosus*
Bird		III	b	Least bittern	*Ixobrychus exilis*
Bird		III	a	Northern bobwhite	*Colinus virginianus*

Bird		III	a	Northern harrier	*Circus cyaneus*
Bird		IV	c	Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bird		IV	b	Virginia rail	*Rallus limicola*
Bird		III	a	Ruffed grouse	*Bonasa umbellus*
Bird		IV	a	Whimbrel	*Numenius phaeopus*
Bird		IV	b	Wood thrush	*Hylocichla mustelina*
Bird		III	a	Yellow-billed cuckoo	*Coccyzus americanus*
Bird		IV	a	Yellow-breasted chat	*Icteria virens*
Crustacean		III	b	Longclaw crayfish	*Cambarus buntingi*
Fish		IV	c	Appalachia darter	*Percina gymnocephala*
Fish	**FS**	III	c	Bigeye jumprock	*Moxostoma ariommum*
Fish		IV	c	Blackside darter	*Percina maculata*
Fish		IV	a	Brook trout	*Salvelinus fontinalis*
Fish	**ST**	II	c	Carolina darter	*Etheostoma collis*
Fish		IV	c	Highback chub	*Hybopsis hypsinotus*
Fish		III	c	Kanawha darter	*Etheostoma kanawhae*
Fish		III	c	Kanawha minnow	*Phenacobius teretulus*
Fish		IV	c	New River shiner	*Notropis scabriceps*
Fish	**FSST**	II	b	Orangefin madtom	*Noturus gilberti*
Fish		IV	c	Piedmont darter	*Percina crassa*
Fish		IV	c	Redlip shiner	*Notropis chiliticus*
Fish		I	a	Roanoke bass	*Ambloplites cavifrons*
Fish		IV	c	Roanoke hog sucker	*Hypentelium roanokense*
Fish	**FESE**	II	a	Roanoke logperch	*Percina rex*
Fish		III	c	Rustyside sucker	*Thoburnia hamiltoni*
Fish		IV	c	Sharpnose darter	*Percina oxyrhynchus*
Fish		III	c	Snail bullhead	*Ameiurus brunneus*
Fish		IV	c	Speckled killifish	*Fundulus rathbuni*
FW Mollusk		IV	a	Creeper	*Strophitus undulatus*
FW Mollusk		IV	c	Gravel elimia	*Elimia catenaria*
FW Mollusk	**ST**	II	a	Green Floater	*Lasmigona subviridis*
FW Mollusk	**FESE**	I	a	James spinymussel	*Pleurobema collina*
FW Mollusk		III	a	Notched rainbow	*Villosa constricta*
FW Mollusk		IV	c	Seep mudalia	*Leptoxis dilatata*
FW Mollusk		II	a	Yellow lampmussel	*Lampsilis cariosa*
Insect	**FSST**	I	c	Appalachian grizzled skipper	*Pyrgus wyandot*
Insect	**FSSE**	I	c	Buffalo Mountain mealybug	*Puto kosztarabi*

Insect	**FS**	I	c	Kosztarab's common stonefly	*Acroneuria kosztarabi*
Insect	**FS**	II	c	Persius duskywing	*Erynnis persius persius*
Insect		II	c	Pygmy snaketail	*Ophiogomphus howei*
Insect	**FS**	I	c	Regal fritillary	*Speyeria idalia idalia*
Mammal		IV	c	Allegheny woodrat	*Neotoma magister*
Mammal		IV	c	Appalachian cottontail	*Sylvilagus obscurus*
Mammal		I	c	Eastern small-footed myotis	*Myotis leibii*
Mammal		IV	c	Eastern spotted skunk	*Spilogale putorius putorius*
Mammal	**FESE**	I	b	Indiana myotis	*Myotis sodalis*
Mammal	**FESE**	II	a	Virginia big-eared bat	*Corynorhinus townsendii virginianus*
Other Terrestrial Invertebrate	**FSST**	I	c	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*
Other Terrestrial Invertebrate	**FSSE**	I	c	Shaggy coil	*Helicodiscus diadema*
Other Terrestrial Invertebrate	**FSSE**	I	c	Spirit supercoil	*Paravitrea hera*
Reptile	**FTSE**	I	a	Bog turtle	*Clemmys muhlenbergii*
Reptile		IV	a	Common ribbonsnake	*Thamnophis sauritus sauritus*
Reptile		III	a	Eastern box turtle	*Terrapene carolina carolina*
Reptile		IV	c	Eastern hog-nosed snake	*Heterodon platirhinos*
Reptile		IV	a	Queen snake	*Regina septemvittata*
Reptile		IV	a	Scarletsnake	*Cemophora coccinea copei*
Reptile		III	a	Smooth greensnake	*Opheodrys vernalis*
Reptile		IV	c	Southeastern crowned snake	*Tantilla coronata*
Reptile	**CC**	IV	a	Timber rattlesnake	*Crotalus horridus (timber)*

APPENDIX B. SGCN SPATIAL ANALYSIS METHODS

Analysis Units

The species data was analyzed within three spatial units for Virginia: county, planning region, and hydrologic unit (HUC12). The source spatial data for these units were provided by Virginia Department of Game and Inland Fisheries (DGIF). The analysis extent was constrained to that of the Virginia counties, so that portions of the planning region and HUC12 units falling outside of the county boundaries were eliminated from the analysis. Each of the 21 planning region units was assigned an alphabetic code (e.g. Accomack-Northampton = "ACNO"). Nottoway County does not fall within the jurisdiction of any Virginia planning region and was not included in any of our analyses.

Species Data

The source data for the species analysis consisted of three datasets, all of which were provided by DGIF: aquatic tier I-II plus species, terrestrial potential and confirmed species, and peer-reviewed HUC12 species. Within these datasets, individual species are identified by Biota of Virginia (BOVA) code.

Methods

Aquatic Species

The aquatic species are represented in the source dataset by linear stream segments, or reaches. For each BOVA code present, the total length was calculated for all assigned reaches within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA length was summarized again by county, planning region, and HUC12. The BOVA percent of total length was calculated by dividing the species length for the analysis unit by the total species length.

Terrestrial Species

The terrestrial species are represented in the source dataset by area. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the three analysis units, and the total BOVA area was summarized again by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area in Virginia.

Peer-Reviewed HUC12 Species

The peer-reviewed species are represented in the source dataset by 6th order hydrologic units. For each BOVA code present, the total area was calculated within the analysis extent. The dataset was then divided by the county and planning region analysis units, and the total BOVA area was summarized by county, planning region, and HUC12. The BOVA percent of total area was calculated by dividing the species area for the analysis unit by the total species area.

Priority SGCN

For each planning region, priority species were identified as those SGCNs with a total planning region unit area or length ≥ 10% of the total SGCN area or length for Virginia. SGCN unit calculations were drawn from only one of the source datasets: if an SGCN was present in both the aquatic dataset and the HUC12 dataset, then the aquatic dataset took preference; and if an SGCN was present in the terrestrial dataset and the HUC12 dataset, then the terrestrial dataset took preference.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Barking treefrog	*Hyla gratiosa*	II	a	Forest	Forests near or within shallow wetlands	The Virginia Fish and Wildlife Information System indicates the loss suitable wetlands constitute the greatest threats to this species. DGIF recommends working to maintain or restore forested buffers surrounding occupied wetlands. These needs are consistent with action plan priorities to conserve and restore wetland habitats and associated buffers. Recently discovered populations within its known range, may indicate this species is more abundant than previously believed. An in-depth investigation into its status may warrant delisting. This species will be prioritized as Tier 2a.
Amphibians	Blue Ridge dusky salamander	*Desmognathus orestes*	IV	c	Forest	High elevation seeps, streams, wet rock faces, and riparian forests	This species' distribution is very limited. Other than limiting logging activity in the occupied areas, no conservation actions have been identified. Unless other threats or actions are identified, this species will be listed as Tier 4c.
Amphibians	Blue Ridge two-lined salamander	*Eurycea wilderae*	III	a	Wetland	Mountain streams and adjacent riparian areas with mixed hardwood or spruce-fir forests up to 6000 feet.	The needs of this species are consistent with priorities for maintaining and enhancing riparian forests and aquatic habitats. This species will be listed as Tier 3a.
Amphibians	Carpenter frog	*Lithobates virgatipes*	III	a	Wetland	Freshwater wetlands with sphagnum moss	The needs of this species are consistent with action plan priorities to preserve and restore aquatic and wetland habitats and water quality. This species will be listed as Tier 3a.
Amphibians	Common mudpuppy	*Necturus maculosus maculosus*	III	a	Wetland	Permanent lakes, ponds, impoundments, streams, and rivers with suitable hiding cover	The needs of this species are consistent with action plan priorities to preserve and restore aquatic habitats and water quality. This species will be listed as Tier 3a.
Amphibians	Cow Knob salamander	*Plethodon punctatus*	I	c	Forest	Site specific - mixed hardwood forests in rocky areas in high elevations	DGIF staff have indicated this species will always face a significant threat of extinction due to its limited range. However, no conservation actions or research have been identified to help conserve this species, most of the habitat is protected via conservation agreements between the U.S. Forest Service and the U.S. Fish and Wildlife Service. As such, it is recommended that this species be prioritized as Tier 1c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Cumberland Plateau salamander	*Plethodon kentucki*	IV	c	Forest	Mature hardwood forests in the vicinity of rocky outcrops	This species requires large stands of mature forests. This habitat type appears to be abundant within this species' distribution. Until additional threats or actions are identified, this species will be listed as Tier 4c.
Amphibians	Dwarf waterdog	*Necturus punctatus*	III	a	Wetland	Sluggish streams and blackwater streams with debris	The needs of this species are consistent with action plan priorities to preserve and restore aquatic habitats and water quality. This species will be listed as Tier 3a.
Amphibians	Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	I	a	Aquatic	Clean streams and rivers with rocky substrates	DGIF staff have recommended this species be listed as a Tier 1a species. The eastern hellbender has been petitioned for protection under the Federal Endangered Species Act. Virginia's populations of hellbenders have been impacted by sedimentation, chemical pollutants, and impoundments in the clear, fast flowing, well oxygenated stream and river habitats they require. Hellbenders are also occasionally caught and killed by anglers fishing for sportfish. Conservation actions identified by DGIF staff include working to maintain and improve water quality, the use of artificial nest boxes, captive propagation, public education, and conducting research to better detect and assess hellbender populations.
Amphibians	Eastern mud salamander	*Pseudotriton montanus montanus*	IV	a	Wetland	Freshwater wetlands with sphagnum moss	The needs of this species are consistent with action plan priorities to preserve and restore aquatic habitats, wetland habitats, and water quality. This species will be listed as Tier 4a.
Amphibians	Eastern spadefoot	*Scaphiopus holbrookii*	IV	c	Forest	Forest and upland habitat generalist but require fish free breeding sites and soils suitable for digging	No conservation actions or research needs have been identified for this species. This species will be listed as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Eastern tiger salamander	*Ambystoma tigrinum*	II	a	Forest	In the east, habitat needs are site specific wetlands within pine savanna. The mountain population utilizes mature forest in proximity to seasonally flooded sinkhole ponds.	This species is known from a handful of sites in the Coastal Plain and the Blue Ridge. The greatest threats include the loss of breeding ponds and the adjacent woodlands. Populations can also be lost if fish are introduced into the breeding ponds. The Virginia Fish and Wildlife Information Service indicates efforts to preserve breeding ponds and associated vegetated buffers should continue. Efforts have been established to maintain existing sites. The single greatest conservation action to protect the Coastal Plain population would be the permanent protection of the Cat Ponds. This species will be prioritized as Tier 2a.
Amphibians	Greater siren	*Siren lacertina*	IV	a	Wetland	Tolerates a variety of warm aquatic habitats with abundant vegetation	The needs of this species are consistent with action plan priorities to preserve and restore aquatic and wetland habitats and water quality. This species will be listed as Tier 4a.
Amphibians	Green salamander	*Aneides aeneus*	II	b	Forest	Damp, but not wet, crevices in shaded rock outcrops and ledges in forested areas	The most significant threat to this species involves logging areas that contain occupied rock outcrops. Conservation action includes maintaining forested buffers around occupied rock outcrops. However, recent investigations indicate this species may be more aboreal than previously believed. These habitats do not appear to be limited within its distribution. Until a more through assessment of its status and habitat usage is completed, a Tier 2b status is warranted.
Amphibians	Jefferson salamander	*Ambystoma jeffersonianum*	IV	a	Forest	West of Shenandoah River - high elevation hardwood forests with suitable breeding ponds.	The needs of this species are consistent with action plan priorities to preserve and restore forested wetlands. This species will be listed as Tier 4a
Amphibians	Lesser siren	*Siren intermedia intermedia*	III	a	Wetland	Tolerates a variety of warm aquatic habitats with abundant vegetation	The needs of this species are consistent with action plan priorities to preserve and restore aquatic and wetland habitats and water quality. This species will be listed as Tier 3a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Little grass frog	*Pseudacris ocularis*	IV	a	Forest	Most abundant in wetlands within pine savanna habitats	The habitat needs of this species are consistent with action plan priorities to preserve and restore wetland habitats and vegetated buffers around wetlands. This species will be listed as Tier 4a.
Amphibians	Mabee's salamander	*Ambystoma mabeei*	II	a	Barren	Pine and hardwood forests with vernal ponds and other water sources suitable for breeding	DGIF indicates the most significant threat to this species involves urban development, forest loss and the draining of vernal ponds. The Virginia Fish and Wildlife Information System indicates known breeding sites and surrounding forested buffers should be conserved. As this need aligns with the priority to conserve riparian forests and large patches of forest in eastern Virginia, this species will be listed as Tier 2a.
Amphibians	Many-lined salamander	*Stereochilus marginatus*	IV	a	Forest	Gum and cypress swamps as well as other wooded wetlands	The needs of this species are consistent with action plan priorities to preserve and restore aquatic and wetland habitats and water quality. This species will be listed as Tier 4a.
Amphibians	Mole salamander	*Ambystoma talpoideum*	II	a	Forest	Hardwood and mixed forests containing fish-free breeding ponds	DGIF indicates the most significant threat to this species involves forest loss and the draining of vernal ponds. The Virginia Fish and Wildlife Information System indicates known breeding sites and surrounding forested buffers should be conserved. As this need aligns with the priority to conserve riparian forests and large patches of forest in eastern Virginia, this species will be listed as Tier 2a.
Amphibians	Mountain chorus frog	*Pseudacris brachyphona*	II	a	Aquatic	Forested areas up to 3500 feet that contain suitable breeding sites	DGIF indicates the most significant threat to this species involves the loss of occupied wetlands and surrounding forests. Conservation actions include maintaining and enhancing wetlands and associated forest buffers. This is consistent with the priority to conserve and restore wetlands. This species will be listed as Tier 2a.
Amphibians	New Jersey chorus frog	*Pseudacris kalmi*	IV	c	Forest	Various forests with suitable breeding sites	No conservation actions or research needs have been identified for this species. This species will be listed as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Northern Pygmy salamander	*Desmognathus organi*	III	c	Forest	Forested habitats in proximity to seeps and springs	This species requires large stands of mature forests and can utilize both spruce-fir, mixed, and deciduous forest types. Mature forests appear to be abundant within this species' distribution. Unless other threats or conservation actions are identified, this species will be listed as Tier 3c.
Amphibians	Oak toad	*Anaxyrus quercicus*	II	a	Forest	Wetlands associated with pine or hardwood savanna habitats with sandy soils.	Conservation actions for this species include working to maintain and restore wetlands and savanna habitats. These needs are consistent with priorities to conserve and restore wetlands and savanna habitats. This species will be listed as Tier 2a.
Amphibians	Peaks of Otter salamander	*Plethodon hubrichti*	I	c	Forest	Site specific - utilizing various forest, rhododendron thickets, and forested talus slopes with deep moist soils	DGIF staff have recommended this species be recatorigized as a Tier 1c species. DGIF staff have indicated this species will always face a significant threat of extinction due to its limited range. However, no conservation actions or research have been identified to help conserve this species, most of the habitat is protected via conservation agreements between the U.S. Forest Service and the U.S. Fish and Wildlife Service. As such, it is recommended that this species be prioritized as Tier 1c. Staff from the Fish and Wildlife Service indicate that populations appear to be stable and not in immediate risk of extinction. Service staff also indicate that the 1997 Conservation agreement for this species outlines specific actions which have contributed to this species' well being.
Amphibians	Shenandoah Mountain salamander	*Plethodon virginia*	III	c	Forest	Site specific - deciduous hardwood forests on mountain slopes and ravines in western Rockingham County	This species requires large stands of mature forests. This habitat type appears to be abundant within this species' distribution. Until additional threats or actions are identified, this species will be listed as Tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Shenandoah salamander	*Plethodon shenandoah*	I	c	Forest	Handful of sites in Shenandoah National Park	Although this species has a very restricted range, its entire distribution occurs on NPS property. The only identified management action is the development of a Management Plan by the NPS. Except for climate change, NPS infrasture development and expansion may be the only other serious threat to theis species. Population appears stable and no DGIF management actions have been identified to further advance the conservation of this species. This species will be prioritized at Tier 1c.
Amphibians	Shovel-nosed salamander	*Desmognathus marmoratus*	III	a	Wetland	Cool highly oxygenated high elevation streams with moderate flow and graveland rock substrates	The needs of this species are consistent with action plan priorities to preserve and restore aquatic habitats and water quality. This species will be listed as Tier 3a.
Amphibians	Southern chorus frog	*Pseudacris nigrita*	IV	c	Forest	Grassy wet areas within or near pine forests	No conservation actions or research needs have been identified for this species. This species will be listed as Tier 4c.
Amphibians	Southern zigzag salamander	*Plethodon ventralis*	II	c	Forest	Hardwood forests in the vicinity of rocky outcrops	This species utilizes mature forests with access to rocky substrates, caves, and other rock features. Although the species has a very limited range in Virginia, this habitat does not appear to be limited within its distribution. Unless additional threats or conservation actions are identified, this species will be listed as Tier 2c.
Amphibians	Weller's salamander	*Plethodon welleri*	I	b	Forest	Either moist cove hardwoods or spruce-fir forests above 2500 feet	DGIF staff have recommended this species be elevated to a Tier 1c species for the following reasons. DGIF Staff have indicated this species will always face a significant threat of extinction due to its limited range. Staff from the USFWS indicated this species has a limited range that likely indicates remaining populations are remnants of a wider historic distribution. This restricted distribution is believed to be a natural occurrence and not the result of anthropogenic habitat destruction. Per the USFS, research is ongoing to determine how climate change may impact this species. This research may help identify additional management actions. As such, this species is being listed as Tier 1b.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Amphibians	Yonahlossee salamander	*Plethodon yonahlossee*	IV	c	Forest	Mature hardwood forests with deep leaf litter layer	This species requires large stands of mature forests. This habitat type appears to be abundant within this species' distribution. Until additional threats or actions are identified, this species will be listed as Tier 4c.
Aq Insects	A limnephilid caddisfly	*Anabolia apora*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	A limnephilid caddisfly	*Nemotaulius hostilis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	A mayfly	*Isonychia tusculanensis*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	A mayfly	*Baetisca rubescens*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A mayfly	*Ephemerella inconstans*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A mayfly	*Habrophlebiodes celeteria*	III	c	Aquatic	Benthic	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A mayfly	*Paraleptophlebia assimilis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A mayfly	*Paraleptophlebia jeanae*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A mayfly	*Rhithrogena anomala*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	A mayfly	*Isonychia arida*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	A mayfly	*Isonychia serrata*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	A philopotamid caddisfly	*Wormaldia thyria*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	A rhyacophilid caddisfly	*Rhyacophila tricornuta*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	A water scorpion	*Nepa apiculata*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	A water strider	*Limnoporus dissortis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Acuminate water boatman	*Ramphocorixa acuminata*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Allegheny mayfly	*Ameletus cryptostimulus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Allegheny river cruiser	*Macromia alleghaniensis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Allegheny snaketail	*Ophiogomphus allegheniensis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	American emerald	*Cordulia shurtleffi*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Appalachian jewelwing	*Calopteryx angustipennis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Appalachian rhyacophilid caddisfly	*Rhyacophila appalachia*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Appalachian snaketail	*Ophiogomphus incurvatus alleghaniensis*	II	c	Aquatic	Breeds in riffle areas of spring-fed piedmont streams. They seem to prefer areas where gravel overlies soft mud in shallow water.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Appalachian stonefly	*Hansonoperla appalachia*	II	c	Aquatic	Pristine medium-sized streams of the elevated Appalachians	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Banner clubtail	*Gomphus apomyius*	IV	c	Aquatic	Creek, medium river	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Beaverpond baskettail	*Epitheca canis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Beaverpond clubtail	*Gomphus borealis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Benfield's bearded small minnow mayfly	*Barbaetis benfieldi*	II	c	Aquatic	Larvae are known from a short reach of the New River. Substrate is metamorphic bedrock with overlying rubble and gravel and with dense mats of riverweed Podostemum ceratophyllum in riffle areas.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Bent forestfly	*Ostrocerca prolongata*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Berner's Ephemerella mayfly	*Ephemerella berneri*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Big stripetail stonefly	*Isoperla major*	I	a	Aquatic	Unknown but stoneflies generally occur in fast flowing water with rocky substrates	This species is known only from a spring on Beartown Mountain near Burkes Garden, Virginia. One specific threat to this species is habitat destruction and degradation from livestock trampling. Management actions include: protection of the spring, either through its incorporation into the Beartown Wilderness Area of Jefferson National Forest, purchase or lease of the property by another conservation entity, or a cooperative agreement with the landowner to protect and improve the site. The recommended research need is looking for other populations. This species will be prioritized as Tier 1a.
Aq Insects	Black-tipped darner	*Aeshna tuberculifera*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Blackwater bluet	*Enallagma weewa*	IV	c	Aquatic	Inhabits slow, shady streams and rivers	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Blue Ridge snowfly	*Allocapnia stannardi*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Blue Ridge springfly	*Remenus kirchneri*	III	c	Aquatic	Small spring-fed streams and seeps of the Blue Ridge region of southwestern Virginia	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Blue Ridge stonefly	*Perlesta frisoni*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Brook snaketail	*Ophiogomphus aspersus*	III	c	Aquatic	lear streams where shallow current ripples over sand	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Burgundy bluet	*Enallagma dubium*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Canada darner	*Aeshna canadensis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Carolina salmonfly	*Pteronarcys scotti*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Carolina spreadwing	*Lestes vidua*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Chalk-fronted corporal skimmer	*Ladona julia*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Cherokee clubtail	*Gomphus consanguis*	II	c	Aquatic	Small shady spring fed streams with mud bottoms	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Cinnamon shadowdragon	*Neurocordulia virginiensis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Coppery emerald	*Somatochlora georgiana*	III	c	Aquatic	Low-gradient streams in forested to partly forested terrain	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Cryptic willowfly	*Taeniopteryx nelsoni*	I	b	Aquatic	Unknown but stoneflies generally occur in fast flowing water with rocky substrates	This species is only known from the streams in Mount Rogers, Virginia. The primary threats are habitat destruction from expansion of the recreational facilities at Mount Rogers National Recreation Area and cattle grazing along Lewis Fork. Management actions include avoiding further development of the watersheds within the distribution of this species. Research needs include establishing water quality and habitat monitoring to pinpoint any deterioration of habitat quality and collecting life history information. This species will be prioritized as Tier 1b. This ranking will be reconsidered when this research need is addressed.
Aq Insects	Delta-spotted spiketail	*Cordulegaster diastatops*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Dot-tailed whiteface	*Leucorrhinia intacta*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Drake's water scorpion	*Ranatra drakei*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Dusky sallfly	*Alloperla biserrata*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Elfin skimmer	*Nannothemis bella*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Elusive clubtail	*Stylurus notatus*	II	c	Aquatic	Large, clear rivers with moderate current and gravel or sandy benthos	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Emerald spreadwing	*Lestes dryas*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Faded pennant	*Celithemis ornata*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Fine-lined emerald	*Somatochlora filosa*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Frosted whiteface	*Leucorrhinia frigida*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Gammon's riffle beetle	*Stenelmis gammoni*	II	c	Aquatic	No specific habitats have been identified but IUCN indicates this species requires clean clear mountain streams	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Georgia Isonychia mayfly	*Isonychia georgiae*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Gray petaltail	*Tachopteryx thoreyi*	IV	c	Forest	Seepage areas in forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Green-faced clubtail	*Gomphus viridifrons*	II	c	Aquatic	Large rivers with rocks and moderate current	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Green-striped darner	*Aeshna verticalis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Hagen's bluet	*Enallagma hageni*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Harpoon clubtail	*Gomphus descriptus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Highlands springfly	*Yugus arinus*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Hoffman's Isonychia mayfly	*Isonychia hoffmani*	II	c	Aquatic	Larvae have been found in second order trout stream and a fourth order cool fast river	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Holston sallfly	*Sweltsa holstonensis*	II	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Hudsonian whiteface	*Leucorrhinia hudsonica*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Illinois snowfly	*Allocapnia illinoensis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Jane's meadowhawk	*Sympetrum janeae*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Johnson's pronggill mayfly	*Leptophlebia johnsoni*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Kanawhole springfly	*Diploperla kanawholensis*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Kosztarab's common stonefly	*Acroneuria kosztarabi*	I	c	Aquatic	Unknown but stoneflies generally occur in fast flowing water with rocky substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 1c.
Aq Insects	Lance-tipped darner	*Aeshna constricta*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Laura's clubtail	*Stylurus laurae*	IV	c	Aquatic	Streams with sand-mud bottoms	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Lilypad clubtail	*Arigomphus furcifer*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Lobed roachfly	*Tallaperla lobata*	II	c	Aquatic	Unknown but stoneflies generally occur in fast flowing water with rocky substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Maine snaketail	*Ophiogomphus mainensis*	IV	c	Aquatic	Clear rivers and streams with strong current over coarse cobbles and with periodic rapids sections	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Manassas stonefly	*Acroneuria flinti*	I	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 1c.
Aq Insects	Mantled baskettail	*Epitheca semiaquea*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Marsh bluet	*Enallagma ebrium*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Martha's pennant	*Celithemis martha*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Maureen's shale stream beetle	*Hydraena maureenae*	II	c	Unknown	The known habitat is a shale bottom Appalachian stream. This species apparently prefers the margins of clear mountain streams, adults sometimes occur on submerged vegetation, but occur mostly among	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
						sand grains.	
Aq Insects	Midland clubtail	*Gomphus fraternus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Mitchell needlefly	*Leuctra mitchellensis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Montane needlefly	*Leuctra monticola*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Mountain river cruiser	*Macromia margarita*	II	c	Aquatic	Small streams to large rivers, usually rocky but with silt deposits	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Moustached clubtail	*Gomphus adelphus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Newfound willowfly	*Strophopteryx limata*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Northern bluet	*Enallagma cyathigerum(different name in Explorer)*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Northern common spreadwing	*Lestes disjunctus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Northern pygmy clubtail	*Lanthus parvulus*	IV	c	Aquatic	Clear streams and brooks with strong current over clean gravel, cobbles or bedrock, on comparatively unproductive soils	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Notched forestfly	*Ostrocerca complexa*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Pale bluet	*Enallagma pallidum*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Piedmont clubtail	*Gomphus parvidens*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Pitcher plant midge	*Metriocnemus knabi*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Pygmy snaketail	*Ophiogomphus howei*	II	c	Aquatic	Large fast flowing rivers	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Rapids clubtail	*Gomphus quadricolor*	III	c	Aquatic	Clear streams and brooks with strong current over clean gravel, cobbles or bedrock, on comparatively unproductive soils ("trout stream")	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Red-waisted whiteface	*Leucorrhinia proxima*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Regal darner	*Coryphaeschna ingens*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Riffle snaketail	*Ophiogomphus carolus*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	River jewelwing	*Calopteryx aequabilis*	IV	c	Aquatic	Small to medium-sized, warm rivers and streams; especially along swiftly flowing riffle segments	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Riverine clubtail	*Stylurus amnicola*	IV	c	Aquatic	Clear rivers with moderate current and gravel or sandy benthos	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Robust baskettail	*Epitheca spinosa*	IV	c	Aquatic	Swamps with some water movement	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Rock Island springfly	*Isogenoides varians*	III	c	Aquatic	Large rivers	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Sable clubtail	*Gomphus rogersi*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Schwarz' diving beetle	*Laccophilus schwarzi*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Sedge sprite	*Nehalennia irene*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Selys' sundragon	*Helocordulia selysii*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Septima's clubtail	*Gomphus septima*	II	c	Aquatic	Small to medium rivers with a rapid current and gravel bottom	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Shenandoah needlefly	*Megaleuctra flinti*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Shenandoah rhyacophilid caddisfly	*Rhyacophila shenandoahensis*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Skillet clubtail	*Gomphus ventricosus*	II	c	Aquatic	Large rivers where they burrow in the soft mud of deep pools	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Ski-tailed emerald	*Somatochlora elongata*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Smokies needlefly	*Megaleuctra williamsae*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Smokies snowfly	*Allocapnia fumosa*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Smoky willowfly	*Bolotoperla rossi*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Southeastern roachfly	*Tallaperla cornelia*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Southern pitcher plant mosquito	*Wyeomyia haynei*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Southern springfly	*Cultus decisus isolatus*	III	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Southern sprite	*Nehalennia integricollis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Spatterdock darner	*Aeshna mutata*	III	c	Aquatic	Sinkhole ponds, bog ponds, small lakes, and artificial ponds; usually fishless	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Spatulate snowfly	*Allocapnia simmonsi*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Sphagnum sprite	*Nehalennia gracilis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Spieth's great speckled olive mayfly	*Siphloplecton costalense*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Spine-crowned clubtail	*Gomphus abbreviatus*	III	c	Aquatic	Clear rivers and streams	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Spiny salmonfly	*Pteronarcys comstocki*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Stripe-winged baskettail	*Epitheca costalis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Stygian shadowdragon	*Neurocordulia yamaskanensis*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Superb jewelwing	*Calopteryx amata*	IV	c	Aquatic	Clear rivers and streams of generally greater than approximately 2 meters width with moderate to strong current over clean gravel and cobbles on comparatively productive soils	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Swamp forestfly	*Prostoia hallasi*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Swannanoa sallfly	*Alloperla nanina*	IV	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Tarter's Ameletus mayfly	*Ameletus tarteri*	II	c	Aquatic	Benthic	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Aq Insects	Teays stonefly	*Perlesta teaysia*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Tennessee sallfly	*Alloperla neglecta*	III	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Treetop emerald	*Somatochlora provocans*	IV	c	Aquatic	Forest or boggy seepages	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Tufted sallfly	*Alloperla banksi*	IV	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Two-striped forceptail	*Aphylla williamsoni*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Variegated meadowhawk	*Sympetrum corruptum*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Vernal sallfly	*Alloperla idei*	III	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Virginia Piedmont water boatman	*Sigara depressa*	I	c	Aquatic	Streams with clean water and healthy riparian areas site specific Per DCR, this species has only been found at one site	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 1c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Aq Insects	Virginia sallfly	*Sweltsa voshelli*	III	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Virginia springfly	*Diploperla morgani*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	White corporal skimmer	*Ladona exusta*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	White sand-river mayfly	*Pseudiron centralis*	IV	c	Aquatic	Clean shifting sand in the fastest portions of the rivers and the sand must be free of silt and must not be compacted	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	White-faced meadowhawk	*Sympetrum obtrusum*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Widecollar stonefly	*Paragnetina ichusa*	III	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Aq Insects	Williamson's emerald	*Somatochlora williamsoni*	IV	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Aq Insects	Zebra clubtail	*Stylurus scudderi*	IV	c	Aquatic	Streams and rivers with slight to moderate current and gravel or sandy benthos	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Alewife floater	*Anodonta implicata*	IV	a	Aquatic	Alewife obligate - coastal streams and lakes with sand or gravel substrates	Propagation and recovery of this species is currently ongoing at VFAWC. Genetics assessment needs to be conducted to determine if the Rappahannock and Pamunkey populations can be used for recovery in the James, Chickahominy and Chowan Basins. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Appalachian monkeyface	*Quadrula sparsa*	I	a	Aquatic	River headwaters with fast flow and various substrates	This species is extremely rare in Virginia and is included in the Virginia Upper Tennessee Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 1a.
AQ Mollusks	Appalachian springsnail	*Fontigens bottimeri*	II	c	Aquatic	Individual springs in Frederick county	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Atlantic pigtoe	*Fusconaia masoni*	I	a	Aquatic	Clean swift waters with stable gravel or sand/gravel substrate	This species is currently being assessed for federal listing as part of the mega aquatics petition. In VA, we only know of 1 stable population that remians and that is in Craig Creek. When the initial tiering was done, the Nottoway River had the largest population from VA 49 and downstream through the Falls area but that population is almost extorpated as the mussel fauna throughout that area has signifcantly declined. This species warrants state endangered status in VA and likely will be proposed during the next reg cycle depending on what happends at the federal level. This species also has declined in NC. Propagation, augmentation, and reintroduction is a possibility with this species. Initial work has been done at White Sulphur Springs NFH and in NC. DGIF should collaborate with NCWRC to make this a reality as work could be done at VFAWC. This species will be prioritized as Tier 1a.
AQ Mollusks	Atlantic spike	*Elliptio producta*	IV	c	Aquatic	Areas with moderate current and sand, rocky, or mud bottom	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
AQ Mollusks	Birdwing pearlymussel	*Lemiox rimosus*	I	a	Aquatic	Riffle areas with stable, sand and gravel substrates in moderate to fast currents in small to medium sized rivers	Propagation and release and habitat protection needs to be continued with this species or extripation is likely. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Black sandshell	*Ligumia recta*	III	a	Aquatic	Medium to large rivers with strong currents and sand, gravel, and cobble substrates	The propagation of this species needs to continue. This species will be prioritized as Tier 2a.
AQ Mollusks	Blue Ridge springsnail	*Fontigens orolibas*	III	c	Aquatic	Springs and cave streams in the Potomac basin and along the Blue Ridge	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Bottle hornsnail	*Pleurocera gradata*	I	c	Aquatic	Rivers	DGThis species is endimic to the Holston drainage and may be extirpated from Virginia. Threats are the same as any other aquatic species, water qulity and habitat loss due to point source and non-point source impacts. This species needs a status assessment before any on-the-ground management can be initiated. This species will be prioritized as Tier 1c.
AQ Mollusks	Brook floater	*Alasmidonta varicosa*	I	b	Aquatic	Clear flowing water with sand or gravel substrates	This species is most likely extripated from VA as it has not been seen live for over 15 years now and is the most rare mussel in the Atlantic Slope in VA and one of the most rare mussels in VA period. The primary locations for the species is/was the Sheanadoah River watershed and the Potomac River watershed. Broad Run in the Potomac used to harbor a population but heavy urban development has impacted this stream. The only live specimens that have been found recently include those in the mainstem Potomac River. Propagation and translocations of this species will need to occur with the cooperation of another state like WV. A regional conservation plan is in development. This species will be prioritized as Tier 1b. This status will be reconsidered when the planning need has been addressed.
AQ Mollusks	Brown walker	*Pomatiopsis cincinnatiensis*	III	c	Aquatic	Amphibious - vegetated banks of streams, creeks, and rivers	DGIF staff recomment this species be listed as Tier 3b. They indicate a status assessment is needed. This conservation action is more consistent with Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Carolina lance mussel	*Elliptio angustata*	IV	c	Aquatic	Clean flowing water with sand and gravel substrates and aquatic vegetation	A detailed genetics asessment needs conducted to determine if angustata is a valid species in VA or if this "species" is simply Elliptio fisheriana. Once determined, a status assessment is needed. This species will be prioritized as Tier 4c.
AQ Mollusks	Carolina slabshell mussel	*Elliptio congaraea*	IV	a	Aquatic	Small streams to rivers with swift flow and sandy substrates	Propagation and recovery efforts for this species are ongoing at VFAWC and this work should continue. This species will be prioritized as Tier 4a.
AQ Mollusks	Chesapeake ambersnail	*Oxyloma subeffusum*	III	c	Aquatic	Terrestrial	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
AQ Mollusks	Coal elimia	*Elimia aterina*	II	c	Aquatic	Little is known about this species' habitat needs. It is found in flowing water in the Clinch and Powell rivers.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Cracking pearlymussel	*Hemistena lata*	I	b	Aquatic	Medium sized rivers with moderate current and mud, sand, and fine gravel substrates	This species is included in the Virginia Upper Tennessee Mussel Restoration Plan Efforts to develop propagation techniques need to continued to be developed. This species is prioritized as Tier 1b. This ranking will be reconsidered when this research need is addressed.
AQ Mollusks	Creeper	*Strophitus undulatus*	IV	a	Aquatic	It is usually found in streams and rivers in a range of flow conditions (rarely in high-gradient streams of mountainous regions) but can tolerate lakes and ponds, particularly in outlets.	Propagation and recovery efforts for this species are ongoing at VFAWC and this work should continue. If the South River NRDAR project comes through, this species will be a focus of recovery. This species will be prioritized as Tier 4a.
AQ Mollusks	Crossed dome	*Ventridens decussatus*	III	c	Aquatic	Terrestrial	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Cumberland bean	*Villosa trabalis*	I	a	Aquatic	Clear, warm streams and small rivers with moderate to swift currents and unsilted sand, gravel, and rubble substrates	This species is likely extirpated from Virginia. The USFWS five-year review document indicates Propagation/Release and habitat protection efforts needs to be continued. This species is prioritized as Tier 1a.
AQ Mollusks	Cumberland moccasinshell	*Medionidus conradicus*	IV	a	Aquatic	Small headwater streams with sand and gravel substrates	This species is included within the Virginia Mussel Restoration Strategy and that propagation efforst should continue. Staff from the U.S. Fish and Wildlife Service indicate "this species has undergone measurable declines in certain portions of its range in Virginia. The status of the species is currently being investigated as it seems to be declining rangewide." Efforts to address water quality threats have been identified. This species will be prioritized as Tier 4a.
AQ Mollusks	Cumberland monkeyface	*Quadrula intermedia*	I	a	Aquatic	Small to medium sized streams with fast current and silt-free sand, gravel, and rubble substrates	This species is extrememly rare in Virginia and is included in the Virginia Upper Tennessee Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 1a.
AQ Mollusks	Cumberlandian combshell	*Epioblasma brevidens*	I	a	Aquatic	Large creeks to large rivers with gravel, cobble, and boulder substrates	Propagation and release and habitat protection needs to be continued with this species or extripation is likely. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Deertoe	*Truncilla truncata*	III	b	Aquatic	This species is a generalized in terms of substrate preference, usually occurring in fine gravel mixed with sand and mud. It is also considered a generalist in terms of the size of rivers it inhabits. It is more common in medium-sized rivers but may become numerous in large rivers, where it can live at depths of 12 to 18 feet. It will also establish viable populations in lakes lacking current	This species is listed in the Virginia Mussel Restoration Strategy. Propagation techniques need to be developed. A status assessment is also needed. This species is rarely found in VA and likely warrants state listing. This species will be prioritized as Tier 3b. This ranking will be reconsidered when the research needs have been addressed.
AQ Mollusks	Dromedary pearlymussel	*Dromus dromas*	I	a	Aquatic	Clean fast moving water with firm, unsilted, sand and gravel substrates	Propagation and release and habitat protection needs to be continued with this species or extripation is likely. This species will be prioritized as Tier 1a.
AQ Mollusks	Dusky Fossaria	*Fossaria dalli*	IV	c	Aquatic	Freshwater	A status assessment is needed for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Dwarf wedgemussel	*Alasmidonta heterodon*	I	a	Aquatic	Clean warm streams and rivers with low to moderate current and unsilted substrates	Propagation and reintroduction efforts need to be initiated with this species. The only suitable broodstock site that may remain is the Po River as this species has not been found in Aquia Creek or the Nottoway River. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Eastern lampmussel	*Lampsilis radiata*	IV	a	Aquatic	Small streams, large rivers, ponds, and lakes. It is found on a wide variety of substrate types, but prefers sand or gravel	Surveys over the past decade have indicated this species is more rare than previously thought. The eastern lampmussel is extant in the Chowan, Potomac and York Basins but in neither basin is the species common. The largest populations exist in the mainstem Nottway, Meherrin and Pamunkey Rivers but the distribution is patchy and the species is not typically common when found. The species should be present in the James, Roanoke, abd Chickahominy given its range in the U.S. but recent records do not exist. This species is currently being propagated with great success at VFAWC so restoration potential is high. This species will be prioritized as Tier 4a.
AQ Mollusks	Eastern pondmussel	*Ligumia nasuta*	IV	a	Aquatic	Areas of limited currents and significant amounts of fine organic matter - can tolerate a wide range of substrates	Propagation and recovery is currently ongoing at VFAWC and this work should continue. This species will be prioritized as Tier 4a.
AQ Mollusks	Elephant ear	*Elliptio crassidens*	III	a	Aquatic	Large creeks to rivers with moderate to swift currents and mud, sand, or rocky substrates	Propagation techniques need to be developed for this species. The restoration of this species in Virginia will only occur through the release of propagated mussels and the recovery of host fish species. This species is also impacted by water quality issues. Actions to address water quality concerns have been identified. This species will be prioritized as Tier 3a.
AQ Mollusks	Elktoe	*Alasmidonta marginata*	II	c	Aquatic	Small shallow rivers with moderately fast current and sand and gravel substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Fanshell	*Cyprogenia stegaria*	I	a	Aquatic	Warm medium to large streams with strong currents and gravel substrates	Propagation and release and habitat protection needs to be continued with this species or extripation is likely. This species will be prioritized as Tier 1a.
AQ Mollusks	Fine-rayed pigtoe	*Fusconaia cuneolus*	I	a	Aquatic	Clear high gradient streams in unsilted gravel and cobble substrates	This species is very rare in Virginia and is included in the Upper Tennessee River Mussel Restoration Plan. Propagation techniques need to be continued to be developed. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Florida pondhorn	*Uniomerus caroliniana*	IV	c	Aquatic	Slack water areas, generally the edges, of small creeks to medium-sized rivers. May inhabit braided channels bottomland hardwood swamps, lakes, temporary overflow pools, and probably artificial waters (e.g., canals, boat basins, impoundments)	A status assessment is needed for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Fluted kidneyshell	*Ptychobranchus subtentum*	II	a	Aquatic	Small to medium rivers with swift current and sand, gravel, or cobble substrates	This species is listed in the Virginia Mussel Restoration Strategy and propagation efforts should continue. Staff from the U.S. Fish and Wildlife Service indicate we should recognize this species will be listed as endangered on April 12, 2015. This species will be prioritized as Tier 2a.
AQ Mollusks	Fragile papershell	*Leptodea fragilis*	IV	c	Aquatic	This species is tolerant of a variety of aquatic habitats and can be found in small streams in strong current with coarse gravel and sand substrates but also rivers or river-lakes possessing slow current and a firm substrate composed of sand and mud. It can occur at depths of up to 15 or 20 feet but reaches greatest population density at normal water levels of three feet or less in areas such as shallow embayments	This species is likely extirpated from Virginia but a status assessment is needed to confirm this suspicion. Additionally, efforts are needed to address the declines of host fish; the freshwater drum (tier 3c). This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Glossy covert	*Fumonelix christyi*	III	c	Aquatic	Terrestrial	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
AQ Mollusks	Golden riffleshell	*Epioblasma florentina aureola*	I	a	Aquatic	No information.	Virginia's populations of golden riffleshell were previously identified as the tan riffleshell. The taxonomy has changed and the tan riffleshell has been divided into two species. Virginia's population is now classified as the Golden Riffleshell (Epioblasma florentina aureola) instead of the Tan riffleshell (E. f. walkeri). Conservation efforts are needed to address mining-related threats to water quality in Indian Creek, Tazewell County. Species is in the upper TN mussel propagation plan. This species will be prioritized as Tier 1a.
AQ Mollusks	Gravel elimia	*Elimia catenaria*	IV	c	Aquatic	Streams and rivers with high ground water content and good flow	A status assessment is needed for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Green Floater	*Lasmigona subviridis*	II	a	Aquatic	Clean, calm water in streams and rivers of various sizes with sand and gravel substrates	A draft conservation plan has been developed and propagation has been intiated with this species with some success. In 2013, over 1,100 propagated individuals were released back to the Tye River and preliminary results indicate good survival. These techniques need to be continued. A draft state conservation plan has been developed for the species, which prioritizes management actions. This species will be prioritized as Tier 2a.
AQ Mollusks	James spinymussel	*Pleurobema collina*	I	a	Aquatic	Clear flowing water with sand, gravel, or cobbel substrates	Propagation with JSM needs to be continued. Techniques have been developed with some success at White Sulphur Springs NFH and are now being conducted at Harrison Lake NFH at VFAWC. In 2013, 532 propagated individuals were released in Mill Creek, Bath County, and data to date show high survival and expected growth. eDNA is being olooked at as a possible presence/absence tool for JSM and potentialy other mussel species as well. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Little-winged pearlymussel	*Pegias fabula*	I	c	Aquatic	High gradient headwater streams	This species is likely extirpated from Virginia but it is included within the Upper Tennessee Mussel Restoration Plan. Given the rarity of this species in VA, intensive surveys need to be conducted to determine its status. Propagation has not been initiated with this species and cannot until broodstock is identified. This species is difficult to find so extirpation cannot be determined at this time unless more intensive surveys are conducted. This species will be prioritized as Tier 1c.
AQ Mollusks	Longsolid	*Fusconaia subrotunda*	III	a	Aquatic	Medium to large rivers with strong currents and sand and gravel substrates	This species is included in the Virginia Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 3a.
AQ Mollusks	Mountain creekshell mussel	*Villosa vanuxemensis vanuxemensis*	IV	a	Aquatic	Very clean small headwaters creeks and streams with sand and gravel substrates and associated with Justicia beds	This species is included within the Virginia Mussel Restoration Strategy. Propagation has been initiated with this species with success and needs to be continued. This species will be prioritized as Tier 4a.
AQ Mollusks	Northern lance mussel	*Elliptio fisheriana*	IV	b	Aquatic	Shallow water near stable banks with intact riparian zones and soft substrates	Propagation techniques need to be developed for the species. This species will be prioritized as Tier 4b. This ranking will be reconsidered when this research need is addressed.
AQ Mollusks	Notched rainbow	*Villosa constricta*	III	a	Aquatic	Clean streams with stable banks and sand or gravel substrates	Propagation and recovery is currently ongoing at VFAWC and this work should continue. This species will be prioritized as Tier 3a.
AQ Mollusks	Oblong ancylid	*Ferrissia parallelus*	IV	c	Aquatic	Quiet, slow-moving water, usually in ponds and lakes, where it attaches to plant surfaces at about 0.3-0.2 metres depth	A status assessment is needed for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Ohio pigtoe	*Pleurobema cordatum*	III	c	Aquatic	Medium and large rivers with flow with gravel, cobble, and boulder substrates, but can also tolerage some reservoir environments	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
AQ Mollusks	Oyster mussel	*Epioblasma capsaeformis*	I	a	Aquatic	Warm creeks and rivers with moderate to swift current and sand, gravel, and boulder substrates	Effort to propagation and release this species need to be continued. Habitat protection efforts should also be continued or extirpation is likely. Translocations have been started for this species in the Clinch River with postiive results; gravid females have been found. This species will be prioritized as Tier 1a.
AQ Mollusks	Panhandle pebblesnail	*Somatogyrus virginicus*	II	c	Aquatic	Very clear flowing water with rocky substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Pearl supercoil	*Paravitrea calcicola*	IV	c	Aquatic	Terrestrial	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Piedmont pondsnail	*Stagnicola neopalustris*	I	c	Aquatic	Freshwater	This species is known from only 1 global record in Orange County. A status assessment needs to be conducted for the species to see if it strill occurs in VA or if it is extinct. This species will be prioritized as Tier 1c.
AQ Mollusks	Pimple back	*Quadrula pustulosa pustulosa*	IV	b	Aquatic	This species has generalized habitat preferences and can maintain abundant and viable populations in shallow to deep sections of large reservoirs as well as in small to medium-sized free-flowing rivers. It is usually found in a substrate consisting of coarse gravel, sand, and	This species is included within the Virginia Mussel Restoration Strategy. Propagation techniques need to be developed for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
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AQ Mollusks	Pink heelsplitter	*Potamilus alatus*	III	b	Aquatic	On a variety of substrates in slow to swiftly flowing water	This species is nearing extirpation in Virginia. Propagation techniques need to be developed. This species will be prioritized as Tier 3b. This ranking will be reconsidered when research needs have been addressed.
AQ Mollusks	Pink mucket	*Lampsilis abrupta*	I	a	Aquatic	Either flowing or standing water with gravel, sand, silt, or mud substrates	This species is likely extirpated from Virginia but it is included within the Upper Tennessee Mussel Restoration Plan. The restoration of this species is part of DGIF mussel propagation program and reintroductions have been initiated in the Clinch River. Reintroductions need to be monitored and cooperation with Tennessee Wildlife Resources Agency needs to be continued for recovery of this species. This species will be prioritized as Tier 1a.
AQ Mollusks	Pistolgrip	*Tritogonia verrucosa*	III	b	Aquatic	Large rivers with gravel, sand, or mud substrates	Propagation techniques need to be developed and status assessment in New River is needed. This species is listed as threatened in VA. The species is restricted to the New River in VA has has seen a significant decline downstream of Claytor Dam. Large populations exist outside of the state so recovery is more likely than with other species where broodstock options are limited. This species will be prioritized as Tier 3b. This ranking will be reconsidered when the research needs have been addressed.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Pocketbook mussel	*Lampsilis ovata*	IV	a	Aquatic	Either flowing or standing water with gravel, sand, silt, or mud substrates	This species is included within the Virginia Mussel Restoration Strategy and that propagation efforts should continue. This species will be prioritized as Tier 4a.
AQ Mollusks	Purple bean	*Villosa perpurpurea*	I	a	Aquatic	Headwaters, creeks, and rivers and can tolerate a variety of currents and substrates	This species is extremely rare in Virginia and is included in the Virginia Upper Tennessee Mussel Restoration Strategy. Propagation techniques have been developed for this species and need to be continued. Priority now is determining the best release sites for the species and properly identifying the species across its range since broodstock locations are limited. Villosa trabilis is similar to purple bean and taxonomic questions have arise regarding where each species actually exists. This species will be prioritized as Tier 1a.
AQ Mollusks	Purple liliput	*Toxolasma lividus*	II	c	Aquatic	Small to medium sized streams in well packed sand or gravel substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Pygmy slitmouth	*Stenotrema pilula*	III	c	Aquatic	Terrestrial	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
AQ Mollusks	Pyramid pigtoe	*Pleurobema rubrum*	II	a	Aquatic	Medium and large rivers with flow and stable mud or mud/sand substrates	This species can be propagated and reintroduced into the Clinch River. A cooperative effort with the Tennessee Wildlife Resources Agency would have the greatest chance of success. This species will be prioritized as Tier 2a.
AQ Mollusks	Rayed bean	*Villosa fabalis*	II	a	Aquatic	Flowing water in headwater creeks with sand and gravel substrates and vegetation	Although it is likely extirpated from Virginia, this species would benefit from translocation efforts. The Tennessee Wildlife Resources Agency has a translocation program. Efforts in Virginia would benefit from a partnership with Pennsylvania.
AQ Mollusks	Ridged lioplax	*Lioplax subcarinata*	IV	c	Aquatic	Clean water with slow currents and sandy substrates, most often found in rivers with stable shorelines and wide riparian forests.	A status assessment is needed for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Roanoke slabshell	*Elliptio roanokensis*	II	b	Aquatic	Deeper channels of relatively fast flowing rivers	Propagation and restoration protocols need to be developed for this species. A more thorough status assessment may be needed as well given the difficulty in identifying this species from other Elliptio. This species will be prioritized as Tier 2b. This status will be reconsidered when these research needs have been addressed.
AQ Mollusks	Rough pigtoe	*Pleurobema plenum*	I	a	Aquatic	Medium to large rivers with sand, gravel, and cobble substrates	This species may be extirpated from Virginia. Propagation can be acomplished with this species through coordination with the Tennessee Wildlife Resources Agency and the speices may be able to be re-established in the lower Clinch River as DGIF is currently attempting with Lampsilis abrupta. This species will be priorotized as Tier 1a.
AQ Mollusks	Rough rabbitsfoot	*Quadrula cylindrica strigillata*	I	a	Aquatic	Warm medium to large rivers with swift currents and silt, sand, gravel, or cobble substrates	This species is included in the Virginia mussel restoration strategy. Propagation techniques must be developed for this species. Water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 1a.
AQ Mollusks	Round peaclam	*Pisidium equilaterale*	IV	c	Aquatic	Freshwater	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Seep mudalia	*Leptoxis dilatata*	IV	c	Aquatic	If this species is consistent with other species in this genus, clean mid-sized rivers with fast flows and rocky substrates	A status assessment is needed for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Sharp sprite	*Promenetus exacuous*	IV	c	Aquatic	No specific habitats have been identified for this aquatic snail but it occurs across most of North America	A status assessment is needed for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Sheepnose	*Plethobasus cyphyus*	II	a	Aquatic	Warm large rivers and reservoirs with gravel and cobble substrates	This species is included in the Virginia Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. Staff from the U.S. Fish and Wildlife Service indicate this species will be listed as endangered on April 12, 2015. This species will be prioritized as Tier 2a.
AQ Mollusks	Shiny pigtoe	*Fusconaia cor*	I	a	Aquatic	Moderate to swift current with stable sand, gravel, or cobble substrates	This species is very rare in Virginia and is included in the Upper Tennessee River Mussel Restoration Plan. Propagation techniques must be developed for this species. Water quality and habitat improvements must continue to be made through BMPs and land-use management. This species will be prioritized as Tier 1a.
AQ Mollusks	Slabside pearlymussel	*Lexingtonia dolabelloides*	II	a	Aquatic	Large creeks to moderat rivers with moderate flow and gravel and sand substrates	This species is included within the Virginia Mussel Restoration Strategy and that Propagation techniques must be developed for this species. Water quality and habitat improvements must be continued to be made through BMPs and land-use management. Staff from the U.S. Fish and Wildlife Service indicate, "This species has undergone significant rangewide decline, and in particularly drastic declines in Virginia. As a result, the species was federally listed as endangered October 28, 2013". They recommend this species be listed as a Tier 1c. Per further conversations with DGIF staff, this species will be listed as Tier 2a.
AQ Mollusks	Slippershell mussel	*Alasmidonta viridis*	I	b	Aquatic	Headwater creeks and small streams with constant flow and mud, sand, or gravel substrates and aquatic vegetation	This species is extremely rare acorss VA and is rarely found depsite the numerous surveys that have been conducted throughout the Upper TN River Basin. Recent live individuals have been found in Plum Creek, Tazwell County, and Copper Creek, Scott County, but the # of individuals ranged from 1 to 5. A thorough status sassessment needs to be conducted for the species and if sufficient broodstock is located, propagation should explored. Survey effort are needed to identify new populations. Preferred headwater stream protections are needed. This species will be prioritized as Tier 1b. This status will be reconsidered as these research needs are addressed.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Snuffbox	*Epioblasma triquetra*	I	a	Aquatic	Small to medium sized creeks with swift current and sand, gravel, and cobble substrates	This species is included in the Virginia Mussel Restoration Strategy. It is a federally endangered species that has declined across its range. Propagation efforts need to continue. Staff from the U.S. Fish and Wildlife This species will be prioritized as Tier 1a.
AQ Mollusks	Spectaclecase	*Cumberlandia monodonta*	I	b	Aquatic	Occurs in large rivers in areas sheltered from the main current, often found in mud and rock substrates	This species is included within the Virginia Mussel Restoration strategy. Fish hosts for this species need to be identified so propaagtion can take place. This is the main priority with this species. Secondary efforts include surveying to identify new populations, as well as protecting areas of preferred habitat (bluff pools with large flat rocks). Staff from the U.S. Fish and Wildlife Service recommend this species be listed as a Tier 1 species. They indicate, "This species has undergone rangewide decline and was federally listed as endangered on March 15, 2012."This species has undergone significant rangewide decline, and declines in Virginia are particularly notable. As a result, the species was federally listed as endangered April 12, 2012. The species is nearing extirpation from Virginia." This species will be prioritized as Tier 1b. This rating will be reconsidered when the research needs related to fish hosts has been addressed.
AQ Mollusks	Spider Elimia	*Elimia arachnoidea*	II	c	Aquatic	Little is known about this species' habitat needs. It has only been found in small streams.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
AQ Mollusks	Spiny riversnail	*Io fluvialis*	III	a	Aquatic	Large rocks and bedrock outcrops in well-oxygenated shallow water with fast current.	This species is included in the Virginia Mussel Restoration Strategy. Propagation and release efforts need to continue and release sites monitored. This species will be prioritized as Tier 3a.
AQ Mollusks	Tennessee clubshell	*Pleurobema oviforme*	III	a	Aquatic	Creeks and small rivers with moderate flow and sand/gravel substrates	This species is included in the Virginia Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 3a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Tennessee heelsplitter	*Lasmigona holstonia*	II	a	Aquatic	Small headwater streams with sand or mud substrates	This species is included in the Virginia mussel restoration strategy. Propagation has been initiated with this species with success. These techniques need to be developed further and release and monitoring of this species is a priority. Status assessement across the species range also is a priority. This species will be prioritized as Tier 2a.
AQ Mollusks	Tennessee pigtoe	*Fusconaia barnesiana*	II	a	Aquatic	Headwater streams to rivers with moderate to high flow and unsilted gravel/sand rubble, or boulder substrates	This species is included in the Virginia Mussel Restoration Strategy. Propagation techniques must be developed for this species and water quality and habitat improvements must be continued to be made through BMPs and land-use management. This species will be prioritized as Tier 2a.
AQ Mollusks	Threeridge	*Amblema plicata*	III	b	Aquatic	Small streams to big rivers, and from locations such as lakes, rivers, and streams with little or no current to areas of very swift current	This species has declined across its range over the past 10 - 15 years such that it is nearing extirpation in Virginia. Propagation techniques need to be developed. This species will be prioritized as Tier 3b. This ranking will be reconsidered when the research needs have been addressed.
AQ Mollusks	Three-ridge valvata	*Valvata tricarinata*	IV	c	Aquatic	Unknown habitat needs in Virginia but in other parts of the country this species is associated with aquatic vegetation	A status assessment is needed for this species. This species will be prioritized as Tier 4c.
AQ Mollusks	Tidewater mucket	*Leptodea ochracea*	IV	a	Aquatic	Ponds, canals, and slow moving sections of rivers, often connected to the ocean. Can tolerate a wide variety of substrates	Propagation and recovery is currently ongoing at VFAWC and this work should continue. This species will be prioritized as Tier 4a.
AQ Mollusks	Triangle floater	*Alasmidonta undulata*	IV	a	Aquatic	Clean streams with stable banks and sand or gravel substrates	Propagation and recovery is currently ongoing at VFAWC and this work should continue. If the South River NRDAR project comes through, this species will be a focus of recovery. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Unthanks Cave snail	*Holsingeria unthanksensis*	I	a	Aquatic	Karst obligate that requires clean water flowing through the system.	Protection of cave habitat is critical for conservation of this species. Efforts to conserve water quality and quantity within karst systems are consistent with other action plan priorities. This species will be prioritized as Tier 1a.
AQ Mollusks	Virginia pigtoe	*Lexingtonia subplana*	I	b	Aquatic	Site specific - cool clean headwater streams with sand and gravel substrates	There are taxonomic questions surrounding this species and the species is likely simply *Fusconaia masoni*. A genetics project could be conducted but sites at which subplana was identified may no longer harbor the species. This species will be listed as Tier 1b. This ranking will be reconsidered when the genetic research need has been addressed.
AQ Mollusks	Virginia springsnail	*Fontigens morrisoni*	I	a	Aquatic	Site specific caves and springs in Bath and Highland counties	Threats to this species results from impaired water quality and diminished water quality. This species is restricted to springs in Bath and Higland County, only 4 known sites, 2 of which have been confirmed in the past decade. Habitat protection with private landowners to protect these springs is the most critical thing that can be done but opportunites are limited. Efforts to conserve water quality and water quantity are consistent with other action plan priorities. This species will be prioritized as Tier 1a.
AQ Mollusks	Yellow lampmussel	*Lampsilis cariosa*	II	a	Aquatic	Large streams and rivers with low gradient and sand and gravel substrates	This species is only know from 3 river basins in VA, the Chowan, Potomac and Roanoke. The species is uncommon in the Nottoway and Meherrin Rivers in the Chowan Basin. The Dan River popualtion was just discovered and only a few individuals were found. The Potomac Basin Population is in decline and the presence of a non-native Lampsilis species may be casuing hybirdization and loss of the species. Propagation and recovery of this species is currently underway at VFAWC and should be continued to augment existing populations and to recover the species in river basins like the James, Chickahominy and Rappahannock. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
AQ Mollusks	Yellow lance	*Elliptio lanceolata*	II	a	Aquatic	Requires slow currents with unsilted sandy substrates and can tolerate a various water sizes	This speciies has experienced signifcnat declines across its range in VA. No stable populations are known. The species is currently under review for federal listing and likely warrants state listing. Propagation of this species is a must and coorination with North Carolina Wildlife Resources Commission is likely needed to achieve this management startegy. NCWRC has been propagating this species for a few years so it can be done. This species will be prioritized as Tier 2a.
Birds	American black duck	*Anas rubripes*	II	a	Wetland	Shallow margins of lakes, streams, bays mud flats, and open waters. Nests in both dry and wet woodlands. Wide variety of wetland habitats in both freshwater and marine situations, in and around marshes, swamps, ponds, lakes, bays, estuaries, and tidal flats.	The greatest management tool for black ducks and other waterfowl is developing hunting regulation to manage harvest and survival rates. Management actions for breeding black ducks include protecting and restoring nesting habitats and managing predator populations. Other management actions include reducing mute swan populations, controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect black duck food resources. There is also a critical research need for assessing and minimizing the threat of future wind farms in the Chesapeake Bay. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	American oystercatcher	*Haematopus palliatus*	II	a	Shoreline	Barrier beaches, salt marshes and Chesapeake Bay islands and shorelines.	VA currently supports the largest Atlantic coast breeding population and the second highest winter population in the US range. Oystercatchers are on the 2015 US shorebirds of conservation concern watch list as a species requiring immediate management action (U.S. Shorebird Conservation Plan Partnership 2015) and they ranked as a species of highest conservation concern in the New England/Mid-Atlantic Coast Bird Conservation Region (BCR30) Implementation Plan (BCR 30 Plan) winter list (ACJV 2008). Best management is already in place - the protection of the barrier islands and seaside marshes from development and most other human activities. Other on the ground management actions include continuation of predator control efforts, area closures and signage at key breeding sites on the barrier islands, Chesapeake Bay islands, and the western shore of the Chesapeake Bay, and public outreach to recreational boaters and beachgoers. Future management measures should include the identification and purchase of suitable inshore marshes and beaches to ensure that suitable breeding habitat is available as coastal fringe islands and marshes subside or become permanently inundated due to sea level rise (SLR) and climate change effects. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	American woodcock	*Scolopax minor*	II	a	Open Habitat	Ideal habitat consists of young forests and abandoned farmland mixed with forested land. Generally considered an edge species.	AMWO breed and winter in VA. AMWO are on the 2015 shorebirds of conservation concern watch list under the management attention category (U.S. Shorebird Conservation Plan Partnership 2015) and are considered a high priority species in the BCR 30 Plan (ACJV 2008). Although the low AI score technically disqualifies the AMWO as a SGCN, it does meet the other Tier II criteria. There is also a North America AMWO conservation plan that provides habitat protection and management guidance for states (Kelly et al. 2008). Efforts are needed to determine its breeding and wintering abundance and distribution in VA (and throughout the eastern management unit). This info is needed to guide habitat management and restoration efforts in Virginia, and to establish state harvest regulations. This species will be prioritized as Tier 2a.
Birds	Bachman's sparrow	*Peucaea aestivalis*	I	a	Open Woodland/ Scrub	Pine savanna/ open pine woodlands	The status of this state-threatened species in Virginia is precarious, but may be improved through re-introductions into stable habitat in mature pine savannas, such as those found on The Nature Conservancy's Piney Grove Preserve in Sussex County. This species will be prioritized as Tier 1a.
Birds	Bank swallow	*Riparia riparia*	III	c	Riparian/C oast	Habitat includes open and partly open situations, frequently near flowing water. Nests are in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, along the edge of inland water, or along the coast, or in gravel pits, road embankments, etc.	Recent analysis by DGIF biologists and conservation partners estimate that >5,000 breeding pairs occur in the Commonwealth. Trend data is not available from the Breeding Bird Survey(BBS) for Virginia. However, trend analysis of the Eastern Region of the BBS has shown the Bank Swallow has shown a statistically significant decline of -7.67% for the time period of 1966 – 2012. The reasons for these declines are not well understood and information on abundance and distribution are lacking. DGIF staff indicate research should focus on abundance and distributional data, nest site surveys, and trend analysis. This species will be prioritized as tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Barn owl	*Tyto alba*	III	a	Open Habitat	Fields of dense grass. Open and partly open country (grassland, marsh, lightly grazed pasture, hayfields) in a wide variety of situations, often around human habitation.	This species utilizes a variety of open vegetated habitats. This speies' habitat needs are consistent with actions outlined within Virginia's Quail Action Plan and associated resources. This species will be prioritized as Tier 3a.
Birds	Belted Kingfisher	*Megaceryle lcyon*	III	b	Aquatic	Primarily along water, both freshwater and marine, including lakes, streams, wooded creeks and rivers, seacoasts, bays, estuaries, and mangroves. Perches in trees, on over hanging branches, posts and utility wires.	The causes of the long-term decline, both in VA and elsewhere, are unclear. Several research efforts have been implemented to attempt to answer this question. None of these efforts have provided definitive results. Research should continue so that management efforts can be identified and implemented. This species will be prioritized as Tier 3b. This ranking will be reconsidered when research needs have been addressed.
Birds	Bicknell's thrush	*Catharus bicknelli*	IV	a	Forest	Migratory with weak habitat associations in Virginia	Virginia's Eastern Shore is a critical migratory habitat for this species. The Bicknell's throughsh' needs during migration, along with those of scores of other migrant birds, are being actively addressed by the Southern Tip Partnership, of which DGIF is an active member. For over two decades the group has been active in land acquisition and restoration on the southern tip of Virginia's Eastern Shore; it has protected and continues to manage over 24,000 acres for the benefit of migratory bird communities. DGIF should continue working with the partnership to enhance and expand the latter's conservation efforts and capacity. Efforts to conserve and restore these habitats should continue. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Black rail	*Laterallus jamaicensis*	I	a	Wetland	High saltmarsh	Black rails were recently listed as state endangered in VA and require immediate attention to stop its extirpation from the state. The greatest threats facing black rails in VA include habitat loss to SLR and climate change effects and avian and mammalian predator pressure (Wilson et al. 2009, Wilson and Watts 2014). Local management actions should include the identification and purchase of suitable inshore high marshes to provide breeding habitat as existing habitats are inundated due to SLR. Artificial impoundments can also be created to provide suitable habitat free of nest predators. Although a broad strategy and site-specific recommendations for managing impoundments still need to be developed, basic requirements include dense grasses that offer adequate cover and very low water levels (i.e, several centimeters in depth). This would require specific flooding and draw down regimes timed specifically to produce optimal conditions for black rails. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Black skimmer	*Rynchops niger*	II	a	Shoreline	Beach species that nests on bare sand	Over the last 20 years, the breeding population of black skimmers experienced significant declines (-51%) in VA (Watts and Paxton 2014). Skimmers were identified as a 2014 species of high conservation concern by the Northwestern Atlantic Marine Bird Cooperative. The greatest threats facing skimmers in VA include habitat loss to SLR and climate change effects and avian and mammalian predator pressure. Most skimmer breeding sites are under permanent protection from development. Additional management measures that should be continued include predator management on the barrier islands, area closures, signage and outreach efforts at key nesting sites, and the suite conservation actions implemented at the Hampton Roads Bridge and Tunnel (HRBT). Future management actions may include the identification and purchase of suitable inshore high marshes and sandy shorelines to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 2a.
Birds	Black-and-white warbler	*Mniotilta varia*	IV	a	#N/A	#N/A	This forest-interior species is a habitat generalist with broad habitat tolerances, and enjoys a widespread distribution within Virginia. Like other area-sensitive species it is potentially subject to the negative effects of forest fragmentation. The species can benefit from conservation and management of large forest blocks. This species will be prioritized as Tier 4a.
Birds	Black-bellied plover (winter)	*Pluvialis squatarola*	IV	a	Shoreline	Winter resident along beaches and estuaries	Best management is already in place - the protection of the barrier islands and seaside marshes from development and most other human activities. Future management measures should include the identification and purchase of suitable inshore marshes and beaches to ensure that suitable breeding habitat is available as coastal fringe islands and marshes subside or become inundated due to SLR and climate change effects. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Black-billed cuckoo	*Coccyzus erythropthalmus*	II	b	Forest	Forest edge and open woodland, both deciduous and coniferous, with dense deciduous thickets.	This species is threatened by habitat fragmentation and the decline of habitat quality quality. Research of these issues appears to be inconclusive and these topics need to be better evaluated with managers in other states to develop habitat treatments and other management strategies. This species will be prioritized as Tier 2b. This ranking will be reconsidered when these research needs are addressed.
Birds	Black-crowned night-heron	*Nycticorax nycticorax*	III	a	Wetland	Variety of marshes, swamps, and wooded streams	The greatest threats to black-crowned night herons in VA are loss of suitable breeding habitat to SLR and climate change effects, and to a lesser extent, predator impacts. Most breeding sites are under permanent protection from development and other human activities. Additional management measures should include area closures, signage and outreach efforts at Chesapeake Bay breeding sites and the identification and purchase of suitable inshore high marshes to ensure habitat is available as coastal fringe marshes subside or become permanently inundated. This species will be prioritized as Tier 3a.
Birds	Brant	*Branta bernicla*	III	a	Wetland	Saltmarshes and estuaries.	Atlantic brant winter trends in VA have been declining for the past 10 years (VDGIF, unpubl. data). The species was identified as a 2014 species of medium conservation concern by the Northwestern Atlantic Marine Bird Cooperative and are considered a highest priority species in the BCR 30 Plan (ACJV 2008). Wintering brant in VA spend most of their time in coastal seaside marshes and lagoon system. A significant management tool for the species is the development of annual hunting regulations to manage harvest and survival rates. Other important management actions include reestablishing eelgrass beds (SAV) in the coastal lagoon system, and controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect the species' food resources. There is also a critical research need for assessing and minimizing the threat of future inshore and offshore wind farms. This species will be prioritized as Tier 3a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Brown thrasher	*Toxostoma rufum*	IV	a	Forest	Thickets and bushy areas in deciduous forest clearings and forest edge, shrubby areas and gardens; in migration and winter also in scrub.	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Canada warbler	*Cardellina canadensis*	IV	b	Wetland	Breeding habitat includes moist thickets of woodland undergrowth (especially aspen-poplar), bogs, tall shrubbery along streams or near swamps, and deciduous second growth.	DGIF is looking toward the newly-formed Canada Warbler International Conservation Initiative for potential collaboration and for products that can help to guide conservation efforts for the species in Virginia. This species will be prioritized as tier 4b. This ranking will be reconsidered after potential conservation actions have been evaluated.
Birds	Cerulean warbler	*Setophaga cerulea*	II	a	Forest	A structurally mature hardwood forest in a mesic or wetter situation, with a closed canopy	This bird of mature forests thrives in areas with heterogeneity in the canopy structure. Because of this, it may respond well to disturbances that can contribute to gaps in the canopy (gypsy moth infestations, ice storms, silvicultural treatments). DGIF is actively participating in a regional collaborative effort in the Appalachians to refine existing silvicultural BMPs for the improvement of Cerulean Warbler habitat. Application of these BMPs should be achievable on a small scale. These efforts should continue. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Chimney swift	*Chaetura pelagica*	IV	b	#N/A	Inhabits rural and urban environments having both an abundance of flying arthropods and suitable roosting/nesting sites.	This species is a diurnal aerial insectivore associated with a variety of habitats throughout its breeding range. It appears to be more prevalent in urban areas where there are greater concentrations of chimneys, which are used as nest sites and communal roosts (Steeves et al. 2014). As the availability of suitable nesting and roosting chimneys continues to decline, so does the swift population. Swifts will use a variety of other artificial structures, and the availability of chimneys may not be the limiting factor for all populations (Steeves et al. 2014). Aerial insectivores as a guild have declined in North America, so that swift declines may be tied to these broader declines . A better understanding of factors limiting swift populations is necessary in order to identify and enact effective conservation and management measures. This species will be prioritized as Tier 4b. This ranking will be reconsidered as these research needs are addressed.
Birds	Clapper rail	*Rallus longirostris*	IV	a	Wetland	Saltmarshes	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 4a.
Birds	Common tern	*Sterna hirundo*	II	a	Shoreline	Nests primarily on open dynamic beaches.	Most common tern breeding sites are under permanent protection from development. Additional management measures that should be continued include predator management on the barrier islands and conservation actions at the Hampton Roads Bridge Tunnel where this species nests in high numbers. Future management may include the identification and purchase of suitable inland marshes and sandy shorelines to ensure future availability of breeding habitat as coastal fringe sites are lost to sea level rise. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Dunlin	*Calidris alpina hudsonia*	IV	a	Shoreline	Winter resident shorelines and estuaries	Although dunlin winter trends are unknown in VA, they are on the 2015 Best management is already in place; the permanent protection of the barrier islands and seaside marshes. However, other wintering sites in the Chesapeake Bay, especially along the western shore, experience varying levels of human disturbance where additional management actions should be deployed such as dog leash laws and area closures on sand shoals and spits with heavy human disturbance. Future management actions may include the identification and purchase of suitable inshore marshes and sandy shorelines to ensure future availability of wintering habitat as coastal fringe sites are lost to SLR. Because of its widespread distribution on VA's the coastal plain, dunlin make it a good umbrella species for all wintering shorebirds that share similar wintering habitats in the Commonwealth. This species will be prioritized as Tier 4a.
Birds	Eastern kingbird	*Tyrannus tyrannus*	IV	a	Open Habitat	Forest edge, open situations with scattered trees and shrubs, cultivated lands with bushes and fencerows, and parks; in winter more closely associated with forest clearings and borders.	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Eastern meadowlark	*Sturnella magna*	IV	a	Open habitat	Grasslands, savanna, open fields, pastures, cultivated lands, sometimes marshes.	This species is a relatively common grassland obligate species which have been undergoing steep declines. These are primarily thought to be due to habitat loss, fragmentation and degradation, though recent studies have also implicated pesticides in the decline of grassland bird populations. Both species would benefit from grassland management and farmland conservation practices, conservation of large blocks of intact grassland, as well as from altered mowing regimes that would improve productivity. This specie will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Eastern towhee	*Pipilo erythrophthalmus*	IV	a	Open Habitat	Inhabits forest and swamp edges, regenerating clearcuts, open-canopied forests, particularly those with a well-developed understory, reclaimed strip mines, mid-late successional fields, riparian thickets, overgrown fencerows, shrub/small-tree thickets, and other brushy habitats.	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Eastern Whip-poor-will	*Antrostomus vociferus*	III	a	Forest	Forest and open woodland, from lowland moist and deciduous forest to montane forest and pine-oak association.	This species is associated with deciduous and mixed forests with open understories (Cink 2002). A variety of additional open habitats may be used for foraging, including fallow fields, croplands, shrublands and regenerating pine stands (Wilson and Watts 2008). Spatial proximity of such habitats to open forests may be beneficial to the species (Wilson and Watts 2008); for example, interspersed harvested patches with mid-rotation patches in managed pine plantations. The species can benefit from conservation, restoration and management of forests with the appropriate degree of openness and/or juxtaposition with open habitats. This species will be prioritized as Tier 3a.
Birds	Eastern wood-pewee	*Contopus virens*	IV	b	Forest	Inhabits a wide variety of wooded upland and lowland habitats including deciduous, coniferous, or mixed forests.	The Pewee is a common bird with a widespread distribution in Virginia. It is a habitat generalist of forested habitats, breeding in both deciduous and coniferous forest and using both interior and edge (including suburban) habitats. High deer populations are potentially implicated in its declines through disturbance via browsing of the intermediate canopy where Pewees forage (McCarty 1996). A better understanding of factors limiting Pewee populations is necessary in order to identify and enact effective conservation and management measures. This species will be prioritized as Tier 4b. This ranking will be reconsidered as these research needs are addressed.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Field sparrow	*Spizella pusilla*	IV	a	Open Habitat	Old fields, brushy hillsides, overgrown pastures, thorn scrub, deciduous forest edge, sparse second growth, fencerows.	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Forster's tern	*Sterna forsteri*	III	a	Shoreline	Nests in marine and estuarine marshes.	Forster's Tern nest in low marsh habitats susceptible to sea level rise and marsh subsidence. Thus, the identification and purchase of suitable inland marshes to offset loss of existing marshes should be undertaken. Other potential management options include building nest platforms in marshes. This species will be prioritized as Tier 3a.
Birds	Glossy ibis	*Plegadis falcinellus*	I	a	Wetland	Wooded wetlands, estuarine marshes and waters and saltmarshes.	Most glossy ibis breeding sites are under permanent protection from development. Predator management on those barrier islands where this species nests should be continued. Future management may include the identification and purchase of suitable inland high marshes to ensure future availability of breeding habitat as coastal fringe sites are lost to sea level rise. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Golden Eagle	*Aquila chrysaetos*	I	a	Open Habitat	Inhabit open and semi-open country such as prairies, sagebrush, arctic and alpine tundra, savanna or sparse woodland, and barren areas, especially in hilly or mountainous regions, in areas with sufficient mammalian prey base and near suitable nesting sites.	The Golden Eagles in the eastern United States represent a distinct and unique sub-population of only 2,000 -5,000 individuals. This is a migratory population that breeds solely in Canada and primarily winters in the Appalachian Mountains from New York to Alabama. A sizable portion (10 – 20%) of this population winters in Virginia. Known threats include incidental take by fur trappers and lead poisoning that results from birds feeding on carrion containing the fragments of lead bullets. Eagle habitat overlaps with areas designated as prime sites for wind energy development. Incidental take by trapping can be greatly diminished by changing trapping regulations and education related to use of bait and terrestrial sets used by trappers. Minimizing lead poising could be reduced through educating hunters of proper disposal of offal piles and use of non-lead ammunition. Wind turbine siting can be modified by utilization of risk assessment models developed by Katzner et. al. These models likely will greatly minimize strike risk but allow siting of turbines in areas of high wind production and low eagle use. This species will be prioritized as Tier 1a.
Birds	Golden-winged warbler	*Vermivora chrysoptera*	I	a	Forest	Open shrubby habitat (ex. old fields and pastures) at mid to high elevations within broader forested matrix west of the Blue Ridge Mountains.	In Virginia, this habitat specialist breeds in open, shrubby habitats within a forested context at mid- to high-elevations within the Appalachian Mountains. 'Working Lands for Wildlife' has been established to improve the species' status via habitat management on private lands aided by federal cost-share. DGIF leads the VA Golden-winged Warbler Partners group to assist with implementation of the program and to enable collaboration with state and regional partners on research and conservation actions. DGIF is also an active participant in the international Golden-winged Warbler Working Group, which in 2012 released a Status Review and Conservation Plan for the species. These efforts should continue. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Grasshopper sparrow	*Ammodramus savannarum*	IV	a	#N/A	#N/A	This species is a relatively common grassland obligate species which have been undergoing steep declines. These are primarily thought to be due to habitat loss, fragmentation and degradation, though recent studies have also implicated pesticides in the decline of grassland bird populations. This species would benefit from grassland management and farmland conservation practices, conservation of large blocks of intact grassland, as well as from altered mowing regimes that would improve productivity. This specie will be prioritized as Tier 4a.
Birds	Gray catbird	*Dumetella carolinensis*	IV	a	Open Habitat	Thickets, dense brushy and shrubby areas, undergrowth of forest edge, hedgerows, and gardens, dense second growth.	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Greater scaup	*Aythya marila*	IV	a	Lake/Pond	Winter resident on tidal rivers	Wintering scaup in VA spend most of their time in coastal nearshore waters, especially near and south of the mouth of the Chesapeake Bay, in the open waters of the lower and middle Chesapeake Bay, and up the major river systems within the Chesapeake Bay watershed. A significant management tool for the species is the development of annual hunting regulations to manage harvest and survival rates. Other important management actions include controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect the species' benthic food resources. There is also a critical research need for assessing and minimizing the threat of future inshore and offshore wind farms. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Green heron	*Butorides virescens*	IV	b	Wetland	Swamps, mangroves, marshes, and margins of ponds, rivers, lakes, and lagoons.	Green herons nesting on the coastal plain experienced a significant 20-year decline (68%; Watts and Paxton 2014) in this part of the state. Because VA's colonial waterbird surveys are confined to the coastal plain, the statewide population is unknown. This species should remain as a SGCN until we have a better handle on statewide population and distribution and ensure some level of protection for the declining coastal population. Nearly half of the green heron coastal population occurs in urban areas; thus, the development of an urban nesting waterbird management plan will provide the necessary guidance to manage these species in urban environments. This species will be prioritized as Tier 4b. This ranking will be reconsidered as planning and research needs are addressed.
Birds	Gull-billed tern	*Gelochelidon nilotica*	I	a	Shoreline	Nests on open sandy beaches and marsh shell rakes.	Gull-billed terns are a state threatened species. Over the last 20 years, gull-billed terns experienced significant declines (-51.5%) in VA (Watts and Paxton 2014). Moreover, gull-billed terns are considered a species of high conservation concern by the Northwestern Atlantic Marine Bird Cooperative. The greatest threats facing the terns in VA include habitat loss to SLR and climate change effects and avian and mammalian predator pressure. Most gull-billed tern breeding sites are under permanent protection from development. Additional management measures that should be continued include predator management on the barrier islands, area closures, signage and outreach efforts at key nesting sites, and conservation actions implemented at the HRBT. Future management actions may include the identification and purchase of suitable inshore marshes and sandy shorelines to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Henslow's sparrow	*Ammodramus henslowii*	I	a	Open vegetated	Open fields and meadows with grass interspersed with weeds or shrubby vegetation, especially in damp or low-lying areas, adjacent to salt marsh in some areas	Efforts to manage habitat at the Radford Arsenal should continue. Monitoring this population should be more consistent. Given its longevity and relative stability, the population at the Radford Arsenal may play an important role in the recovery of the species in Virginia. The addition of a monitoring component would be important in gauging whether current management efforts are benefiting the breeding population. Lastly, DGIF should work with land managers at the Radford Arsenal to adopt relevant conservation actions outlined in the national Conservation Plan as a first step in adapting the Plan to VA. This species will be prioritized as Tier 1a.
Birds	Kentucky warbler	*Geothlypis formosa*	III	a	Forest/ wetland	Humid deciduous forest, dense second growth, swamps.	This species is associated with bottomland hardwoods and woods near streams with dense understory, often at low elevations. Although some deleterious and some beneficial silvicultural practices have been identified (McDonald 2013), BMPs to benefit Kentucky Warbler have not been generated. The species is potentially sensitive to forest fragmentation (Dunn and Garret 1997). The species can benefit from conservation, restoration and management of large forest blocks and of vegetated riparian corridors. This species will be prioritized as Tier 3a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	King rail	*Rallus elegans*	II	b	Wetland	Variety of fresh water and marine marshes and wetlands	This species occupies marshes of different salinity gradients, and all populations are threatened by wetland loss and degradation. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. A DGIF-funded study is currently underway to characterize King and Clapper Rail populations in a potentially important area of co-occurrence and to develop a methodology to distinguish between the higher-ranked King Rail and the lower-ranked Clapper Rail by ear. This will allow for identification of important King Rail sites in order to prioritize conservation efforts toward the latter in areas of potential co-occurrence. This species will be prioritized as Tier 2b. This ranking will be reconsidered when the research needs are addressed.
Birds	Laughing Gull	*Leucophaeus atricilla*	IV	a	Beach/ open water	Seacoasts, bays, estuaries, rarely on large inland bodies of water.	The LAGU breeding population in Northampton Co. has declined significantly (~80%) due to SLR and marsh subsidence. Similar declines occurred in the seaside marshes behind Cedar and Parramore islands in Accomack County. However, there are several LAGU control programs in place to benefit other nesting birds or increase human safety (i.e., Chincoteague NWR staff control LAGU numbers on Assateague Island at key piping plover breeding areas; USDA Wildlife Services shoot and harass LAGUs at commercial and military airports; and an annual LAGU egg oiling program is in place at the Hampton Roads Bridge Tunnel (HRBT) designed to reduce LAGU reproductive success and discourage them from nesting there). DGIF staff should continue to engage in discussions pertaining to controlling LAGUs for the benefit of other breeding waterbirds and human safety. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Least bittern	*Ixobrychus exilis*	III	a	Wetland	Freshwater marshes	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 3a.
Birds	Least tern	*Sterna antillarum*	III	a	Shoreline	Nest on open beaches	While over half of VA's LETE pop nests on the protected barrier islands, significant numbers nest at sites with a high degree of human disturbance including Craney Island Dredge material Disposal Area, Grandview Nature Preserve and at 2 mall rooftops. Management actions (e.g., signage, outreach efforts, area closures, etc.) at these sites need to continue as does predator management on the barrier islands. Future management may include the identification and purchase of suitable inshore shorelines to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 3a.
Birds	Little blue heron	*Egretta caerulea*	II	a	Wetland	Freshwater and brackish marshes	The greatest threats to the species in VA are loss of suitable breeding habitat to SLR and climate change effects, and to a lesser extent, predator impacts. Most breeding sites are under permanent protection from development and other human activities. Predator management, area closures, signage and outreach efforts should continue on the barrier islands where this species nests. Future management measures should include area closures, signage and outreach efforts at Chesapeake Bay and western shore sites and the identification and purchase of suitable inshore high marshes to ensure habitat is available as coastal fringe marshes subside or become permanently inundated. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Loggerhead shrike	*Lanius ludovicianus*	I	a	Open vegetated	Grasslands, orchards and open areas with scattered trees	The Loggerhead Shrike Working Group, with DGIF as a founding member, has begun addressing research needs through a regionally-coordinated project which is expected to produce a conservation plan for the species, which is state-threatened in Virginia. The project includes trapping and banding of shrikes and subsequent monitoring, with much of the work taking place on private lands. Because this entails coordination with the landowner, it also provides an opportunity for outreach and to enhance the conservation potential of the sites. These efforts should continue. This species will be prioritized as Tier 1a.
Birds	Marbled godwit	*Limosa fedoa*	IV	a	Shoreline	Seaside lagoon system throughout the winter.	Best management is already in place; the permanent protection of the barrier islands and seaside marshes. However, other wintering sites in the Chesapeake Bay, especially along the western shore, experience varying levels of human disturbance where additional management actions should be deployed such as dog leash laws and area closures on sand shoals and spits with heavy human disturbance. Future management actions may include the identification and purchase of suitable inshore marshes and sandy shorelines to ensure future availability of wintering habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 4a.
Birds	Marsh wren	*Cistothorus palustris*	IV	a	Wetland	Freshwater marshes with cattails and reeds	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Nelson's sparrow (winter	*Ammodramus nelsoni*	III	a	Wetland	Wintertime resident of maritime wetlands	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 3a.
Birds	Northern bobwhite	*Colinus virginianus*	III	a	Open Habitat	Early successional habitats including croplands, grasslands, pastures, grass-brush rangelands, and open forests	DGIF has an active, multi-faceted Quail Recovery Initiative, including a landowner outreach and technical support program through Private Lands Biologists, a multi-partner Virginia Quail Council and a Northern Bobwhite Quail Action Plan for Virginia, among other components. These efforts should continue. This species will be prioritized as Tier 3a.
Birds	Northern Flicker	*Colaptes auratus*	IV	b	Forest	Open forest, both deciduous and coniferous, open woodland, open situations with scattered trees and snags, riparian woodland, pine-oak association, parks.	Causes of this species' decline are not immediately apparent. The species is fairly plastic in its selection of habitat, utilizing woodlands, forest edges, open fields with scattered trees, as well as city parks and suburbs. Habitat does not appear to be a limiting factor. Hypotheses relating to the decline of Flicker populations include competition from European Starlings for nest cavities; declining availability of suitable nest-cavity substrate (snags, dead limbs, and live trees with heart rot via suburban expansion, dead and diseased tree removal from urban and suburban areas, and ineffective dead-limb maintenance policies on public lands); and pesticide application on golf courses, agricultural fields and suburban lawns (Wiebe and Moore 2008). While management policies relating to snag retention on public lands can be pursued at any time, properly identifying factors limiting Flicker populations is an important first step. This species will be prioritized as Tier 4b. This ranking will be reconsidered when research needs have been addressed.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Northern Gannet	*Morus bassanus*	IV	a	Aquatic	Coastal waters primarily but sometimes several hundred miles out to sea.	A significant number of gannets winter in and near the mouth of the Chesapeake Bay and in nearshore ocean waters. Management actions include controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect gannets' food resources. There is also a critical research need for assessing and minimizing the threat of future wind farms in the Chesapeake Bay and in offshore waters. This species will be prioritized as Tier 4a.
Birds	Northern harrier	*Circus cyaneus*	III	a	Wetland and Open habitat	Marshes, meadows, grasslands, and cultivated fields.	Harriers occur in relatively low numbers as breeders in Virginia, where they may be found using both open marshes and open upland grassland habitat. Their numbers swell during the winter with the influx of migrants, and it is this winter population that should be the focus of conservation efforts. Like other grassland species, Harriers rely on relatively large tracts, such that preserving and restoring blocks of native grasslands is a high priority conservation action for this species. Wintering harriers will likewise use emergent wetlands; identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for this species. This species will be prioritized as Tier 3a.
Birds	Northern Pintail	*Anas acuta*	IV	a	Wetland/ Aquatic	Lakes, rivers, marshes and ponds in grasslands or cultivated fields.	The greatest management tool for pintails and other waterfowl is developing hunting regulations to manage harvest and survival rates. Other management actions include reducing mute swan populations, controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect pintail food resources. There is also a critical research need for assessing and minimizing the threat of future wind farms in the Chesapeake Bay. This species will be prioritized as Tier 4a.
Birds	Northern rough-winged swallow	*Stelgidopteryx serripennis*	IV	c	Open Habitat	Open and partly open situations, especially along watercourses with steep banks, and roadside cuts	Basic population and life history information is lacking for this species. Therefore few if any management opportunities are currently available due to this information gap. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Northern saw-whet owl	*Aegolius acadicus*	I	c	Forest	Higher elevation coniferous woodlands in Blue Ridge and mountains west of Shenandoah River	Very little is known about this species in Virginia. Beyond targeted Northern Saw-whet Owl banding during migration and winter, the only survey work on the species to date in Virginia was a targeted Foray conducted by the Virginia Society of Ornithology in 2006 (Dolby and Mellinger 2006), which detected individuals along 7 of 16 routes surveyed. It is recommended that these efforts be expanded in order to gain a better baseline understanding of the status of Saw-whets in the Appalachians of Virginia, including distribution, abundance and gross habitat and landscape-level characteristics. Another significant data gap is population trend, as the species is not adequately monitored by existing programs. Such an effort would probably require at least a decade worth of monitoring prior to yielding robust trend data. If pursued, such an effort should take place at a broad scale that encompasses the entire southern Appalachian population; this could perhaps be accomplished in cooperation with an entity such as the Appalachian Mountains Joint Venture, which lists the Northern Saw-whet Owl as a Moderate Priority species. This species will be prioritized as Tier 1c. This status will be reconsidered when research needs have been addressed.
Birds	Peregrine falcon	*Falco peregrinus*	I	a	Mountains/ Urban	Human structures in the east and cliff sites in the west	Recovery of this state-threatened species is currently the focus of efforts by DGIF and its partners. DGIF supports monitoring and management of the coastal population, and leads efforts to survey and monitor the mountain population, which is key to the species' recovery in Virginia. Targeted hacking has proven to be successful at two sites in the mountains (Shenandoah National Park, Breaks Interstate Park) and could be expanded to additional sites; the number of occupied sites in the mountains has grown in recent years, and surveys are underway to document new breeding sites. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Piping plover	*Charadrius melodus*	II	a	Shoreline	Barrier beaches and sand spits	Predator management, area closures, signage and outreach efforts should continue on the barrier islands. Deployment of nest exclosures on Assateague and Assawoman islands should continue as deemed necessary by refuge staff. Future management may include the identification and purchase of suitable inshore beaches to ensure future availability of breeding habitat as coastal fringe sites are lost to sea level rise. This species will be prioritized as Tier 2a.
Birds	Purple sandpiper	*Calidris maritima*	IV	c	Shoreline	Winter resident along beaches and jetties	Managers need to confirm distribution of this species and determine VA population status before on-the-ground management actions can be identified. Most occur on rock revetments and other artificial structures; thus, managers may be able to identify additional protective measures for these artificial habitats. This species will be prioritized as Tier 4c.
Birds	Red crossbill (Type I)	*Loxia curvirostra*	III	c	Forest	Spruce-fir or hemlock forests above 4000 feet	There are likely <500 breeding pairs of Red Crossbill in Virginia and the Virginia population does not significantly contribute to the overall population (Area Importance Score <2). However, despite the low Area Importance score this species should be kept on the WAP list as it serves as a representative of the Spruce-Fir forest communities (albeit and imperfect representative as it is nomadic). The only actions identified include developing a population assessment, trend analysis, and implementing general life history studies. This species will be prioritized as Tier 3c.
Birds	Red knot	*Calidris canutus rufus*	I	a	Shoreline	Migrant along barrier islands and to a lesser extent in the Chesapeake Bay.	Best management is already in place - the protection of the barrier islands and seaside marshes. There are outstanding issues such as the impacts of peregrine falcons on knots that should be researched as well as SLR impacts to habitat and prey availability. Future management actions may include the identification and purchase of suitable inshore marshes and beaches to ensure future availability of stopover habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Red-cockaded woodpecker	*Picoides borealis*	I	a	Forest	Pine savanna	DGIF continues its annual support of Red-cockaded Woodpecker (RCW) surveys at The Nature Conservancy's Piney Grove Preserve, where the only known Virginia population of this federally endangered species resides. The surveys are used to monitor the status of the small population and to guide management at the Preserve. Standardized management prescriptions are outlined in the Federal Recovery Plan for the species, and are well-documented and used across its range. In addition, there is a draft VA Conservation Plan for the woodpecker to help guide conservation actions. Finally, DGIF participates in an active partnership of RCW Cooperators in VA which continues to move forward with management, land acquisition and conservation planning for the species. These efforts should continue. This species will be prioritized as Tier 1a.
Birds	Red-throated loon	*Gavia stellata*	IV	a	Shoreline and open water	Primarily bays, seacoasts and estuaries, less frequently on lakes and rivers (nonbreeding).	A significant number of red-throated loons winter in and near the mouth of the Chesapeake Bay, in the seaside lagoon system (in some years) and in nearshore ocean waters. Management actions include controlling TMDLs and reducing eutrophication in the Chesapeake Bay to protect the loon's food resources. There is also a critical research need for assessing and minimizing the threat of future wind farms in the Chesapeake Bay and in offshore waters. This species will be prioritized as Tier 4a.
Birds	Royal tern	*Thalasseus maxima*	IV	a	Shoreline	Sandy beaches	Currently, nearly the entire breeding pop occurs at the Hampton Roads Bridge Tunnel where they require considerable management (i.e., avian (gull) predator control, area closures to vehicular and human traffic, barriers to keep young from entering I-64, vegetation management). Future management may include the identification and purchase of suitable inshore shorelines to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Ruffed Grouse	*Bonasa umbellus*	III	a	Forest	Dense forest with some deciduous trees, in both wet and relatively dry situations from boreal forest (especially early seral stages dominated by aspen) and northern hardwood ecotone to eastern deciduous forest and oak-savanna woodland.	Grouse numbers have declined as open habitats have been developed or lost due to natural succession. VDGIF and partners are working collaboratively under the auspices of the national Ruffed Grouse Conservation Plan (Dessecker et al. 2006) in order to create open habitats to benefits this species and other. This species will be prioritized as Tier 3a.
Birds	Rusty blackbird	*Euphagus carolinus*	IV	b	Open vegetated	Wooded swamp and wooded wetland winter habitat	This boreal breeder winters in Virginia and across the southeastern United States. The International Rusty Blackbird Technical Working Group was formed in 2005 to guide collaborative research and conservation efforts for the species across both its breeding and wintering range. As an active participant in the Group, DGIF guided VA's 2009-2011 participation in Winter Blitzes for the species. Migration Blitzes, being coordinated in VA by the Virginia Society of Ornithology, are entering their 2nd year. The Blitzes have provided us with information on general distribution and flock size relative to other parts of the wintering range. Although the Blackbird is more numerous south of VA, Virginia still has a role to play in the species' recovery. Winter ecology research over the past several years has focused on populations in the more southern part of the range; such research may not be completely applicable to VA due to differences in the availability of some of the primary habitats that are used (ex. pecan orchards). Coordination with the Working Group is expected to continue as the Group moves toward drafting a Conservation Plan. This species will be prioritized as Tier4b. This ranking will be reconsidered as this planning need is addressed.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Saltmarsh sparrow	*Ammodramus caudacutus*	III	a	Wetland	Maritime wetlands around estuaries and barrier islands	There are estimated <5,000 breeding pairs and populations are presumed to have experienced moderate declines over the past 50 years. This species is threatened by wetland loss and degradation. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for this species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 3a.
Birds	Sanderling	*Calidris alba*	IV	a	Beaches and mudflats	Primarily sandy beaches, less frequently on mud flats and shores of lakes or rivers also on exposed reefs.	Best management action is already in place; the protection of the barrier islands and seaside marshes. Other wintering sites such as Grandview Nature Preserve and the eastern and western shore of the Chesapeake Bay may require additional protection to minimize human disturbance during the winter. Future management may include the identification and purchase of suitable inshore high marshes to ensure future availability of wintering habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 4a.
Birds	Seaside sparrow	*Ammodramus maritimus*	IV	a	Wetland	Grassy salt marshes	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Short-billed dowitcher	*Limnodromus griseus*	IV	a	Shoreline	Migrant, migration habitat includes saltwater tidal flats, beaches, and salt marshes	Best management is already in place - the protection of the barrier islands and seaside marshes, which are key stopover sites in VA. However, other migration sites in the Chesapeake Bay, especially along the western shore, experience varying levels of human disturbance where additional management actions should be deployed such as dog leash laws and area closures on sand shoals and spits with heavy human disturbance. Future management actions may include the identification and purchase of suitable inshore marshes and sandy shorelines to ensure future availability of stopover habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 4a.
Birds	Snowy Egret	*Egretta thula*	II	a	Wetland	Marshes, lakes, ponds, lagoons, mangroves, and shallow coastal habitats.	Most SNEG breeding sites are under permanent protection from development. Predator management on those barrier islands where SNEGs nest should be continued. Future management may include the identification and purchase of suitable inshore high marshes to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 2a.
Birds	Swainson's warbler	*Limnothlypis swainsonii*	II	c	Forest	Forested moist lower slopes with a rhododendron shrub layer	In Virginia the species has two disjunct populations: one occurring in the Southeast Coastal Plain in association with bottomland hardwoods and cane stands, the other one in the Appalachian Mountains in association with rhododendron thickets and cove hardwoods. Little work has been conducted on either population. Gaining a better understanding of the species' status in VA, as well as its limiting factors, is a priority that will lead to identification and enactment of management actions. This species will be prioritized as Tier 2c.
Birds	Virginia rail	*Rallus limicola*	IV	a	Wetland	Fresh and brackish marshes, may visit salt marsh in winter	This species is threatened by the loss and degradation of wetland habitats. Identification, protection and management (ex. phragmites control) of suitable marshes will be necessary to ensure continued habitat availability for these species, especially as coastal marshes subside or are threatened with sea level rise. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Wayne's black-throated green warbler	*Setophaga virens waynei*	I	c	Forest	Cypress and white cedar swamps	The Wayne's Warbler is a subspecies of the Black-throated Green Warbler. The Black-throated Green Warbler occurs in Virginia in two distinct, reproductively isolated populations: one in the Appalachian Mountains, the other (S.v. waynei) in the Southeast Coastal Plain. The latter is a small population breeding in coastal swamps from Virginia to South Carolina. Within Virginia, it is currently documented only from the Great Dismal Swamp. Gaining a better understanding of this subspecies' status and distribution in Virginia is a priority that will enable identification and enactment of management actions. This species will be prioritized as Tier 1c.
Birds	Whimbrel	*Numenius phaeopus*	IV	a	Shoreline	Coastal migrant that typically occurs in a variety of saltmarsh habitats.	Best management is already in place; the protection of the barrier islands and seaside marshes. Other less used stopover sites may require additional protection measures such as dog leash laws and area closures on sand shoals and spits with heavy human disturbance. Future management actions may include the identification and purchase of suitable inshore marshes and sandy shorelines to ensure future availability of stopover habitat as coastal fringe sites are lost to SLR. Work is ongoing to develop morphometric and genetic techniques to identify sub-populations to better understand the extent of mixing and clarify population-level implications. This species will be prioritized as Tier 4a.
Birds	Willet	*Tringa semipalmata*	III	a	#N/A	#N/A	DGIF staff have recommended this species be added to the SGCN list as a Tier 3a species. WILLs breed on the barrier islands and in seaside, Chesapeake Bay and coastal river marshes. Identified management actions for this species includes: continued predator and human disturbance management on the barrier islands; human disturbance management on western shore recreational beaches through area closures, signage and outreach efforts; and the identification and purchase of suitable inshore marshes and sandy shorelines to ensure habitat is available in the future as coastal fringe marshes subside or become inundated. This species will be prioritized as Tier 3a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Wilson's plover	*Charadrius wilsonia*	I	a	Shoreline	Barrier beaches	Although VA is the northern extreme of the Wilson's plover nesting range, annual productivity rates suggests the species' breeding population should be increasing rather than remaining static (25-30 prs). In 2014, a working group was formed because of rangewide population concerns which will provide an opportunity to collaborate on rangewide research efforts such as banding and resighting birds to determine site fidelity, survivorship, and age at first breeding. Locally, predator management, area closures, signage and outreach efforts should continue on the barrier islands, where VA's entire breeding population occurs. Future management may include the identification and purchase of suitable inshore beaches to ensure future availability of breeding habitat as coastal fringe sites are lost to SLR. This species will be prioritized as Tier 1a.
Birds	Wood thrush	*Hylocichla mustelina*	IV	b	Forest	Deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist.	While forest conservation and management on the breeding grounds are actions that have already been identified for the Wood throughsh, this is one of the first songbird species for which a full-life cycle model is being developed by the Smithsonian Migratory Bird Institute. The model will identify limiting factors in different stages of the species' life cycle, which will allow for identification and prioritization of conservation actions in the appropriate geographic regions (ex. breeding vs. wintering grounds). This species will be listed as Tier 4b, until research needs are addressed.
Birds	Yellow-billed cuckoo	*Coccyzus americanus*	III	a	Forest	Open woodland (especially where undergrowth is thick), parks, deciduous riparian woodland.	This species is associated with open woodland with clearings and shrubby vegetation, and is often associated with watercourses (Hughes 1999). It is thought to be sensitive to habitat fragmentation and to degradation of riparian woodlands (Hughes 1999). The species can benefit from conservation, restoration and management of large forest blocks and of vegetated riparian corridors. This species will be prioritized as Tier 3a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Birds	Yellow-breasted chat	*Icteria virens*	IV	a	Open Habitat	Second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation	This species utilizes early-successional habitats and would benefit from creation and maintenance of early-successional habitat. DGIF's efforts to create these habitats should continue. This species will be prioritized as Tier 4a.
Birds	Yellow-crowned night-heron	*Nyctanassa violacea*	II	a	Wetland	Marshes, swamps, lakes, lagoons, and mangroves; chiefly coastal.	This species is threatened by the loss of suitable habitat to development, SLR, erosion and marsh subsidence. 97% of the current population breeds in urban neighborhoods and we have identified "on the ground" species management strategies that have showed some signs of success (working with communities and residents to discourage birds from nesting in areas where they are considered a nuisance. In addition, the development of an urban nesting waterbird management plan will provide the necessary guidance to manage these species in urban environments. Management and planning efforts should continue. This species will be prioritized as Tier 2a.
Crustaceans	Alleghany County cave amphipod	*Stygobromus hoffmani*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Allegheny crayfish	*Orconectes obscurus*	IV	c	Aquatic	Clean flowing streams with rocky substrates	Limited range in VA (Potomac River Basin and Cowpasture River watershed) and populations are relatively rare and populations are being impacted by the invasive virile crayfish (Orconectes virilis); obscurus is noticably smaller when sympatric with virilis.
Crustaceans	An amphipod	*Crangonyx acicularis*	III	c	Aquatic	Small springs adn spring-fed streams	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	An amphipod	*Crangonyx montanus*	III	c	Aquatic	Springs, spring-fed swamps, and spring-fed ponds	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Appalachian Valley cave amphipod	*Crangonyx antennatus*	III	c	Cave/Karst	Small cave streams and cave pools fed by ceiling drips and wall seepage	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Bath County cave amphipod	*Stygobromus mundus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Big Sandy Crayfish (aka Guyandotte River Crayfish)	*Cambarus veteranus*	I	c	Aquatic	Warm streams with fast flows and bedrock, cobble, boulder, and sand substrates	This species is being reviewed for endangerd status at the federal level. Genetics studies have shown that the BSC populations in the Russell Fork watershed are distinct from the populations in the Levisa Fork watershed at the management level. Also, Cambarus veteranus is now known only to occur in the Guyondotte watershed in WV and BSC occurs throughout the rest of the range, restricting BSC even more. Major impacts are coal mining. Staff recommend this species be monitored, particularly in the Dismal Creek watershed at this is the only population in the Levisa Fork watershed in Virginia. This species will be prioritized as Tier 1c.
Crustaceans	Big Stone crayfish	*Cambarus spp.1*	I	c	Aquatic	Unknown	Only 1 population of this species is known, downstream of Cherry Reservoir near Big Stone Gap in the Powell River watershed. This species is threated by water quality impairments resulting from logging, chlorine spills downstream of WTP and management of reservoir (e.g., burning off lower reservoir and add chemicals to remove nutrients from reservoir). This is most restricted crayfish in VA. No specific management actions are provided. This species will be prioritized as Tier 1c.
Crustaceans	Bland County amphipod	*Crangonyx fontinalis*	II	c	Aquatic	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Blue crayfish	*Cambarus monongalensis*	II	a	Aquatic	Burrowing species that utilizes wooded hillsides with springs and seeps.	This species is known from only 5 sites in VA within Highland County. It also occurs in 5 counties in WV. This species utilizes a very specific habitat type. People modifying springs are a major impact. Management actions include working with willing landowners to conserve and restore these springs thru acquisition, easement, or agreement. This species will be prioritized as Tier 2a.
Crustaceans	Blue Ridge spring amphipod	*Stygobromus spinosus*	III	c	Groundwater	Groundwater but found where springs emerge; individuals are in gravel substrate, leaf mats and vegetation (such as cress).	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Burnsville Cove cave amphipod	*Stygobromus conradi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Chowanoke crayfish	*Orconectes virginiensis*	III	a	Aquatic	Sluggish streams and swamps with abundance of dead wood on the bottom	This species is only known from the Chowan drainage. Fair number of populations in the Chowan but it is difficult to find populations with substantial numbers. The species appears to be gradient restricted and impacted by sediment. In watersheds where it is present, this species would benefit from the implementation of sediment control BMPS. This species will be prioritized as Tier 3a.
Crustaceans	Coalfields crayfish	*Cambarus theepiensis*	II	c	Aquatic	Unknown	This species is confined to small portion of the Big Sandy Basin. Populations are small and not widespread. Potential impacts from mineral extraction could be significant but no specific management actions have been identified. This species will be prioritized as Tier 2c.
Crustaceans	Craig County cave amphipod	*Stygobromus estesi*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Cumberland cave amphipod	*Stygobromus cumberlandus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Cumberland Gap cave amphipod	*Bactrurus angulus*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 1c.
Crustaceans	Cumberland Gap cave isopod	*Caecidotea cumberlandensis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Dismal Swamp isopod	*Caecidotea attenuatus*	II	c	Freshwater	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Ephemeral cave amphipod	*Stygobromus ephemerus*	I	a	Cave/Karst	Subterranean obligate	This species is endemic to Giles County and occurs in two caves - one which has a gate. Human impacts from caving are a likely threat. Management actions include: protection of the caves through acquisition, easements, or cooperative agreements and groundwater protection from pollution and alteration. Life history is an important research need. Staff from DCR/Natural Heritage have also indicated land development could pose a threat to this species. This species will be prioritized as Tier 1a.
Crustaceans	Finley's cave amphipod	*Stygobromus finleyi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Henrot's Cave isopod	*Caecidotea henroti*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Incurved Cave isopod	*Caecidotea incurva*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Lancaster County amphipod	*Crangonyx baculispina*	I	c	Aquatic	Site specific - non-karst subterranean - requires clean groundwater	Very little is known about this species. No threats have been identified. Realistic management actions could include groundwater protection and protection of specific sites where this species is confirmed in the future. Life history and distribution information are research needs. This species will be prioritized as Tier 1c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Lee County cave amphipod	*Stygobromus leensis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Lee County cave isopod	*Lirceus usdagalun*	III	c	Cave/Karst	Caves with clean abundant water flowing through the system.	While this species is endemic to a small area, numerous effective protective measures are currently in place. It is unclear what additional measures may be necessary. This species will be prioritized as Tier 3c.
Crustaceans	Lee County terrestrial cave isopod	*Ligidium elrodii leensis*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Longclaw crayfish	*Cambarus buntingi*	III	a	Aquatic	Clean creeks and streams with sand, gravel, clay, or silt substrates	This species is believed to occupy the Russell Fork watershed in the Big Sandy Basin and the Clinch River watershed of the upper TN River Basin. However, the populations within the 2 river basins may be different species. If the populations are indeed different species, the tier ranking should be II. A genetics study must be conducted to determine this info and determine proper management. This species (or two species) are impacted by degraded water quality issues resulting from mining operations and row crop agriculture in the Clinch River watershed. All populations would benefit from efforts to conserve and restore water quality. This species will be prioritized as Tier 3a.
Crustaceans	Luray Caverns amphipod	*Stygobromus pseudospinosus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Madison Cave amphipod	*Stygobromus stegerorum*	I	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species is endemic to Augusta County and is found in two cave lakes. No specific threats have been identified but disturbance to the sinkhole recharge systems and water pollution are likely threats. Realistic management actions could include: boundaries of the watersheds that feed these lakes should be determined to allow for surface protection and the second cave (Stegers Fissure) needs to be incorporated into the existing management plan. Research needs include researching life history and water quality monitoring. This species will be prioritized as Tier 1b. This ranking will be reconsidered as research needs are addressed.
Crustaceans	Madison Cave isopod	*Antrolana lira*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Montgomery County cave amphipod	*Stygobromus fergusoni*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Morrison's cave amphipod	*Stygobromus morrisoni*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Natural Bridge cave isopod	*Caecidotea bowmani*	III	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	New Castle Murder Hole amphipod	*Stygobromus interitus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Northern spring amphipod	*Gammarus pseudolimnaeus*	IV	c	#N/A	#N/A	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Northern Virginia well amphipod	*Stygobromus phreaticus*	I	c	Cave/Karst	Non-karst species - site specific restricted to seeps and aquifer on Ft. Belvoir	This species' known remaining population is located on Fort Belvoir with fair to poor condition habitat. No specific threats are known. If populations are found within the area where previously confirmed, then habitat protection should occur. If additional populations are found research should include careful monitoring and searches for additional populations. This species will be prioritized as Tier 1c.
Crustaceans	Ohio River shrimp	*Macrobrachium ohione*	IV	c	Aquatic	Low velocity water, borders of main channel	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Crustaceans	Phreatic isopod	*Caecidotea phreatica*	I	c	Specialist	Shallow subterranean groundwater habitats	Likely threats to this species are water contamination/pollution and reduction of groundwater for human use. No management actions have been identified. Research needs include researching life history and distribution. This species will be prioritized as Tier 1c.
Crustaceans	Pittsylvania well amphipod	*Stygobromus obrutus*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Pizzini's amphipod	*Stygobromus pizzinii*	II	c	Cave/Karst	Non-karst groundwater habitats in Arlington and Fairfax county	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Powell Valley terrestrial isopod	*Amerigoniscus henroti*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Racovitza's terrestrial cave isopod	*Miktoniscus racovitzai*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Reticulate crayfish	*Orconectes erichsonianus*	III	c	Aquatic	Streams with rocky substrates	This species has a limited range within VA and is difficult to find in the Clinch, Powell, and North Fork Holston River watersheds. It tends to be restricted to the lower portion of the watersheds. Major impacts are sedimentation and invasive species impacts from Orconectes cristavarius and Orconectes virilis in the Clinch, Orconectes rusticus in the NF Holston. This species would benefit from the implementation of BMPs that reduce the flow of sediments into rivers and streams. This species will be prioritized as Tier 3a.
Crustaceans	Rock Creek groundwater amphipod	*Stygobromus kenki*	II	c	Groundwater	Dead leaves or fine sediment submerged in the waters of their spring-seep outflows in subterranean small springs and spring like seeps; often with intermittent flow and periods of drying in late summer or early fall	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Rockbridge County cave amphipod	*Stygobromus baroodyi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Crustaceans	Rye Cove isopod	*Lirceus culveri*	I	a	Cave/Karst	Caves with clean abundant water flowing through the system.	This species is endemic to Scott County and is found in one cave. It is threatened by stream perturbation and groundwater pollution. Management actions acquisition or closing of McDavids Cave and groundwater protection. Research needs include: study of its life history is needed and additional surveys to determine if this species is truly endemic. This species will be prioritized as Tier 1a.
Crustaceans	Scott County terrestrial cave isopod	*Ligidium elrodii scottensis*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Spiny scale crayfish	*Cambarus jezerinaci*	II	a	Aquatic	High elevation high gradient spring fed streams	In watersheds where this species occurs, this species would benefit from the implementation of sediment control BMPS. This species will be prioritized as Tier 2a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Crustaceans	Surgeon crayfish	*Orconectes forceps*	IV	c	Aquatic	Streams with rocky substrates	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Crustaceans	Tidewater amphipod	*Stygobromus indentatus*	III	c	Groundwater	Shallow interstitial groundwater habitats of unconsolidated Coastal Plain sediments	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Tidewater interstitial amphipod	*Stygobromus araeus*	III	c	Groundwater	Shallow interstitial groundwater habitats of unconsolidated Coastal Plain sediments	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Crustaceans	Tug Valley crayfish	*Cambarus hatfieldi*	II	c	#N/A	#N/A	This species is only found in a small region of Tazewell County and only 1 population is known in VA in the Big Sandy Basin in Dry Branch. Distribution of this species extends into the Levisa Fork in WV and the population appears stable. Given its rarity and limited distribution, this population is recommended as near threatened and vulnerable. No specific management actions are provided. This species will be prioritized as Tier 2c.
Fish	Alewife	*Alosa pseudoharengus*	IV	a	Aquatic	Migratory	This species would benefit from efforts to enhance aquatic connectivity. This is consistent with action plan priorities to enhance aquatic connectivity. Status and distribution surveys, population monitoring, and habitat modeling is needed to prioritize and evaluate the effectiveness of efforts to restore aquatic connectivity. This species will be prioritized as Tier 4a.
Fish	Allegheny pearl dace	*Margariscus margarita*	IV	b	Aquatic	Pools of small creeks and rivers with sand or gravel substrate	Research is needed to determine how climate change might impact this species. This species will be prioritized as tier 4b. This status will be reconsidered as these research needs are addressed.
Fish	American brook lamprey	*Lampetra appendix*	IV	c	Aquatic	Requires clear flowing water but can tolerate a range of temperatures and substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	American eel	*Anguilla rostrata*	III	a	Aquatic	Migratory uses variety of freshwater and marine habitats	This species has suffered population declines over much of its range due to overfishing and barriers to upstream and downstream migration in the form of dams and culverts that deny it access historical habitats. This species would benefit from efforts to restore aquatic connectivity. This action is consistent with action plan priorities to restore aquatic connectivity. Research needed to determine the need and effectiveness of these efforts include monitoring this species' status, distribution, and habitat. This species will be prioritized as Tier 3a.
Fish	American shad	*Alosa sapidissima*	IV	a	Aquatic	Large unfragmented migratory rivers for spawning	This species would benefit from efforts to enhance aquatic connectivity. This is consistent with action plan priorities to enhance aquatic connectivity. Status and distribution surveys, population monitoring, and habitat modeling is needed to prioritize and evaluate the effectiveness of efforts to restore aquatic connectivity. This species will be prioritized as Tier 4a.
Fish	Appalachia darter	*Percina gymnocephala*	IV	c	Aquatic	Clear, cool and warm streams in the New drainage with upland gradient and gravel substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Ashy darter	*Etheostoma cinereum*	I	b	Aquatic	Clear cool or warm streams with moderate gradient with rubble and boulder substrates	Additional surveys are required within the Powell to determine if sufficient habitat is available to justify a propagation or reintroduction effort for this species. This species will be prioritized as Tier 1b.
Fish	Atlantic sturgeon	*Acipenser oxyrinchus*	I	b	Aquatic	Migratory - utilize variety of aquatic and marine habitats	The following research needs should be addressed to inform a the creation of a robust recovery strategy. developing information on abundance and trends in abundance for each distinct population segment, developing information on habitat use (spawning grounds, nursery areas, foraging areas, and overwintering areas) for each distinct population segment, and developing information on the threats impacting each distinct population segment. This species will be prioritized at Tier 1b.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Banded sunfish	*Enneacanthus obesus*	IV	c	Aquatic	Blackwater swamps, ponds, and streams with thick vegetation	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Bigeye jumprock	*Moxostoma ariommum*	III	c	Aquatic	Moderate gradient streams with unsilted rubble, boulder, or rock outcrop substrate	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Black sculpin	*Cottus baileyi*	IV	c	Aquatic	Cold creeks and streams with moderate to high gradient and clean gravel and boulder substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c. r
Fish	Blackbanded sunfish	*Enneacanthus chaetodon*	I	a	Aquatic	Acidic pools, creeks, and swamps with thick vegetation	DGIF Staff indicated this species is currently restricted to 5 sites in the Blackwater and Nottoway river systems. Direct conservation actions include propagation and reintroduction. Staff also indicate additional survey efforts and habitat modeling are needed. This species will be prioritized as Tier 1a.
Fish	Blackside darter	*Percina maculata*	IV	c	Aquatic	Clean streams and rivers with moderate gradient and various substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Blotched chub	*Erimystax insignis*	IV	c	Aquatic	Clean, cool to warm, streams and rivers with moderate gradient and clean gravel and rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Blotchside logperch	*Percina burtoni*	II	a	Aquatic	Clear warm moderate gradient rivers with gravel or rubble substrates	This species was identified as a candidate for reintroduction into the Powell River. This effort would benefit from additional population monitoring and habitat modeling. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Blueback Herring	*Alosa aestivalis*	IV	a	Aquatic	Habitat includes riverine, estuarine, and Atlantic coastal waters; also in certain lakes and reservoirs in the southeastern United States.	This species would benefit from efforts to enhance aquatic connectivity. This is consistent with action plan priorities to enhance aquatic connectivity. This species is also likely to benefit from captive propagation and augmentation efforts. Status surveys, distribution surveys, population monitoring, and habitat modeling would help determine the need and effectiveness of these efforts. This species will be prioritized as Tier 4a.
Fish	Bluebreast darter	*Etheostoma camurum*	IV	c	Aquatic	Clear warm streams and rivers with moderate gradient with silt free gravel, rubble, or boulder substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Blueside darter	*Etheostoma jessiae*	IV	c	Aquatic	Clear creeks and small rivers with sand and gravel substrates with moderate to swift flow.	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Bluestone sculpin	*Cottus sp. 1*	III	c	Aquatic	Cool or cold limestone spring runs with strong flows and gravel or rubble substates and aquatic vegetation	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Brassy Jumprock	*Moxostoma sp.*	IV	c	Aquatic	Silty to rocky pools and slow runs of large creeks and small to medium rivers; impoundments	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Bridle shiner	*Notropis bifrenatus*	I	a	Aquatic	Slow clear water with aquatic vegetation	This species would benefit from augmentation and reintroduction efforts. Additional habitat modeling would be useful. This species will be prioritized as Tier 1a.
Fish	Brook silverside	*Labidesthes sicculus*	IV	c	Aquatic	Clear cool or warm lakes and large rivers and can tolerage various substrates and various amounts of aquatic	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
						vegetation	
Fish	Brook Trout	*Salvelinus fontinalis*	IV	a	Aquatic	Clear, cool, well-oxygenated creeks, small to medium rivers, and lakes	Virginia's brook trout populations are threatened by a variety of factors including siltation/erosion of stream banks, increasing water temperatures caused by inadequate riparian buffers, and acid precipitation. Conservation efforts are needed to conserve and restore existing brook trout habitats. The secondary priority would involve working to restore water quality and riparian buffers in watersheds where brook trout are thought to have been extirpated. These actions are consistent with action plan priorities to conserve and restore aquatic habitats and improve water quality. This species will be prioritized as Tier 4a.
Fish	Bullhead minnow	*Pimephales vigilax*	IV	c	Aquatic	Pools, backwaters, and quiet runs of small to large rivers having continuous flow and low to moderate gradient, over sand, silt, or gravel	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Candy darter	*Etheostoma osburni*	I	b	Aquatic	Clear creeks and streams with rocky substrates	This species is only known from four streams in the New River Drainage. Its conservation needs include investigating reintroduction into historic range, habitat modeling, and population viability analysis/genetics. This species will be prioritized as Tier 1b. This status will be reconsidered as these research needs are addressed.
Fish	Carolina darter	*Etheostoma collis*	II	c	Aquatic	Very slow moving water with sand or gravel substrates flowing through wooded areas or pastures	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Carolina fantail darter	*Etheostoma brevispinum*	IV	c	Aquatic	Rocky riffles of creeks and small to medium rivers	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Channel darter	*Percina copelandi*	III	c	Aquatic	Warm rivers with moderate to swift flows and gravel and rubble substrate	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Clinch dace	*Chrosomus sp. cf. saylori*	I	a	Aquatic	Small high elevation streams with gravel substrates and forested watersheds	This species occurs in nine streams in the Clinch River. Conservation needs include reducing sedimentation, reducing chemical impairments associate with mining, reducing bacterial impairments associated with livestock or insufficient sewage treatment, removing stream impediments, and implementing baitfish regulations. These needs are consistent with action plan priorities to conserve and restore aquatic habitats and improve water quality. Research needs include distribution and monitoring, population modeling, and habitat modeling. Education and outreach efforts would be beneficial. This species will be prioritized as Tier 1a.
Fish	Clinch sculpin	*Cottus sp. 4*	III	c	Aquatic	Cold clear spring runs to rivers with moderate to high gradients and unsilted gravel, rubble, and boulder substraites	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Dusky darter	*Percina sciera*	IV	c	Aquatic	Warm streams and rivers with low gradients and unsilted gravel substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Duskytail darter	*Etheostoma percnurum*	I	a	Aquatic	Clear, warm, moderate gradient intermontane streams and rivers with clean gravel, rubble, or boulder substrates	This species would benefit from habitat restoration efforts that reduce erosion and sediment input. These needs are consistent wtih action plan priorities to conserve and restore aquatic habitats and improve water quality. Staff also indicate this species would benefit from additional monitoring to determine if reintroductions might be feasible. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Emerald shiner	*Notropis atherinoides*	IV	c	Aquatic	Clear large streams and rivers with low gradient	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Fatlips minnow	*Phenacobius crassilabrum*	II	c	Aquatic	Clear moderate to high gradient streams and rivers with clean gravel, rubble, and boulder substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 2c.
Fish	Freshwater drum	*Aplodinotus grunniens*	III	c	Aquatic	Warm turbid water in lakes, reservoirs, and pools in low gradient rivers over mud substrate	DGIF staff involved with the freshwater mussel program indicate the freshwater drum is the only known fish host for the fragile papershell. Without the drum's restoration, the fragile papershell's restoration will likely be impossible. Baseline information is required to better understand this the freshwater drum's habitat requirements. This species will be prioritized as Tier 3c.
Fish	Golden Darter	*Etheostoma denoncourti*	II	b	Aquatic	Shallow gravel riffles of small to medium rivers; riffles and runs with substrates largely of pea gravel	Formerly the Tippecanoe Darter before taxonomy changed. This species is a habitat specialist that has proven to be particularly vulnerable to sedimentation. Research is needed to determine if this species could be reintroduced to the Powell River. This research would require additional status and distribution surveys, population monitoring, and habitat modeling. This species will be classified as Tier 2b. This status will be reconsidered when these research needs have been addressed.
Fish	Greenfin darter	*Etheostoma chlorobranchium*	I	b	Aquatic	Clear high gradient streams with rocky substrates	Research needs for this species include population monitoring, habitat modeling especially related to temperature changes, and determining if suitable areas exist to support a reintroduction effort. This species will be prioritized as Tier 1b. This status will be reconsidered as these research needs are addressed.
Fish	Highback chub	*Hybopsis hypsinotus*	IV	c	Aquatic	Warm water (either clear or turbid) with sandy or rocky bottoms	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Highfin Shiner	*Notropis altipinnis*	IV	c	Aquatic	Pools, sometimes runs, of shallow, generally small streams (avg. 3-10 m wide) usually lacking vegetation, with substrate of sand and gravel (occasionally rubble); bedrock outcrops sometimes present; water varies from white to brown with moderate current	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Holston sculpin	*Cottus sp. 5*	III	c	Aquatic	Clear streams with moderate to high gradient and clean gravel, rubble, or boulder substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Ironcolor shiner	*Notropis chalybaeus*	III	c	Aquatic	Moderately acidic creeks, streams, and swamps	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Kanawha darter	*Etheostoma kanawhae*	III	c	Aquatic	Clear creeks and streams with rocky substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Kanawha minnow	*Phenacobius teretulus*	III	c	Aquatic	Clear moderate gradient streams with clean gravel and rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Lake chubsucker	*Erimyzon sucetta*	IV	c	Aquatic	Clear to slightly stained warmwater ponds, lakes, ditches, and streams	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Least brook lamprey	*Lampetra aepyptera*	IV	c	Aquatic	Warm small streams with slow flows and sand/silt substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Lined topminnow	*Fundulus lineolatus*	IV	c	Aquatic	Moderately acidic margins of swamps and creeks with dense vegetation	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Logperch	*Percina caprodes*	IV	c	Aquatic	Warm, moderate gradient, streams and rivers with gravel and rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Longear Sunfish	*Lepomis megalotis*	IV	b	Aquatic	Clear, shallow, well-vegetated areas of low-gradient streams, can be found in some reservoirs	This species is considered to be rare within its native range in the upper Tennessee River and suffers from competition with other *Lepomis* species. Research is needed to determine if this species could benefit from propagation and augmentation efforts. Additional status surveys, distribution surveys, habitat modeling, and population modeling would support this research need. This species will be prioritized as Tier 4b. This status will be reconsidered as these research needs are addressed.
Fish	Mirror shiner	*Notropis spectrunculus*	III	c	Aquatic	Clear warm moderate gradient rivers with gravel or rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Mountain brook lamprey	*Ichthyomyzon greeleyi*	III	c	Aquatic	Cool creeks or streams with moderate flow and clean substrates with access to pool sediments and muddy banks for ammocoetes	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Mountain madtom	*Noturus eleutherus*	IV	c	Aquatic	Clear, warm streams and rivers with gravel and rubble substrates and vegetated riffles	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Mountain shiner	*Lythroughrus lirus*	IV	c	Aquatic	Typically in clear, flowing, riffle-pool type creeks and small rivers with moderate gradients and bottom materials ranging from sand- gravel to rubble-boulder	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Mud sunfish	*Acantharchus pomotis*	IV	c	Aquatic	Swamps, ponds, and slow moving water	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	New River shiner	*Notropis scabriceps*	IV	c	Aquatic	Small to large, cool water, tributaries of the New River with high to moderate gradient and unsilted substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Northern studfish	*Fundulus catenatus*	IV	c	Aquatic	Cutoff pools, backwaters, and sluggish margins of clear, warm, moderate gradient creeks, streams and rivers with a variety of substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Notchlip redhorse	*Moxostoma collapsum*	IV	c	Aquatic	Riverine species: specific habitat details are unknown	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Ohio lamprey	*Ichthyomyzon bdellium*	IV	c	Aquatic	Large warm rivers with clean gravel and rubble substrates and access to low gradient areas with soft substrates and detrital material for ammocoetes	This species restricted to the Tennessee drainage in Virginia. The species is naturally a low-density animal and is somewhat difficult to sample because larval stages live buried in sediment and thus are not often vulnerable to traditional sampling techniques. This species appears to be common and secure. Research is needed to determine if this species still warrants inclusion within the wildlife action plan. This species will be prioritized as Tier 4b. This status will be reconsidered as this research need is addressed.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Orangefin madtom	*Noturus gilberti*	II	b	Aquatic	Moderate to strong flows with unsilted substrates	Research is needed to determine if this species could be reintroduced into suitable habitats. This research would require additional status and distribution surveys, population monitoring, and habitat modeling. This species will be classified as Tier 2b. This status will be reconsidered when these research needs have been addressed.
Fish	Paddlefish	*Polyodon spathula*	IV	c	Aquatic	Warm medium to large rivers with very low flows	Baseline information is required to better understand this species' habitat requirements. This effort could be enhanced using eDNA. This species will be prioritized as Tier 4c.
Fish	Piedmont darter	*Percina crassa*	IV	c	Aquatic	Cool and warm moderate gradient creeks and rivers with clean gravel and rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Popeye shiner	*Notropis ariommus*	II	c	Aquatic	Clear warm moderate gradient rivers with gravel or rubble substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 2c.
Fish	Redlip shiner	*Notropis chiliticus*	IV	c	Aquatic	Clear creeks and streams with moderate gradient, warm or cool water and various substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	River redhorse	*Moxostoma carinatum*	III	b	Aquatic	Clean streams and rivers with unsilted gravel, rubble, and boulder substrates	Research is needed to determine if this species could be reintroduced into the North Fork Holston River. Species distribution and status surveys would support this effort. This species will be prioritized as Tier 3b. This status will be reconsidered when these research needs have been addressed.
Fish	Roanoke bass	*Ambloplites cavifrons*	I	a	Aquatic	Warm large creeks, streams, and small rivers with low gradient and typically clear water	Many of this species' historic habitats are now occupied by rock bass. Conservation needs include propagation and reintroduction into suitable habitats that lack rock bass. Research is needed to determine the genetic viability of Roanoke bass in habitats shared with rock bass. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Roanoke hog sucker	*Hypentelium roanokense*	IV	c	Aquatic	Moderate to high gradient streams with rock, gravel, or sand substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Roanoke logperch	*Percina rex*	II	a	Aquatic	Warm clear stream and rivers with low to moderate gradient and unsilted substrate	Reintroduction and augmentation efforts for this species should be continued. Monitoring to determine the need and effectiveness of these efforts should be expanded. This species will be prioritized as Tier 2a.
Fish	Roughhead shiner	*Notropis semperasper*	I	b	Aquatic	Clear medium sized streams with moderate current	Research needs for this species include determining the competitive interaction with congeners i.e., N. telescopus, conducting distribution/status surveys, population monitoring, and habitat modeling. This species will be prioritized as Tier 1b. This status will be reconsidered as these research needs are addressed.
Fish	Rustyside sucker	*Thoburnia hamiltoni*	III	c	Aquatic	Clean clear streams with moderate to high gradient and unsilted substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Sand shiner	*Notropis stramineus*	IV	c	Aquatic	Warm streams with low to moderate gradient and clean sand and gravel substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Sauger	*Sander canadensis*	III	b	Aquatic	Cool large streams, rivers, and lakes with a combination of deep swift runs and backwaters	This species is very rare in the Clinch and Powell rivers. Research is needed to species propagation and reintroduction efforts. Status surveys, distribution surveys, population monitoring, and habitat modeling would support these reintroduction efforts. This species will be prioritized as Tier 3b. This status will be reconsidered as these research needs are addressed.
Fish	Sharphead darter	*Etheostoma acuticeps*	I	c	Aquatic	Clear, cool or warm streams and rivers with moderate gradient and rubble and boulder substrates with growths of riverweed	Baseline information is required to better understand this species' status, distribution, and habitat requirements. This species will be prioritized as Tier 1c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Sharpnose darter	*Percina oxyrhynchus*	IV	c	Aquatic	Moderate gradient streams and rivers with unsilted gravel, rubble, and boulder substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Shortnose sturgeon	*Acipenser brevirostrum*	I	a	Aquatic	Migratory - utilize variety of aquatic and marine habitats	The status of this species could be enhanced via a cooperative propagation and reintroduction effort with the US Fish and Wildlife Service. This species will be prioritized as Tier 1a.
Fish	Sickle Darter	*Percina williamsi*	I	c	Aquatic	Flowing pools over rocky, sandy, or silty substrates in clear creeks or small rivers	This species was originally referred to as the longhead darter before the taxonomy changed. The sickle darter is a rare fish species of the Clinch and Holston drainages (Jenkins and Burkhead 2014). It is restricted to 7 isolated populations in Virginia and naturally occurs in low density and has only been documented twice since 2005. Baseline information is required to better understand this species' status, distribution, and habitat requirements. This species will be prioritized as Tier 1c.
Fish	Silver redhorse	*Moxostoma anisurum*	III	c	Aquatic	Silty to firm-bottomed pools and runs of small to large rivers; also in natural lakes and impoundments	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Slender chub	*Erimystax cahni*	I	c	Aquatic	Clear, open, and swift streams and rivers with unsilted gravel substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 1c.
Fish	Slimy sculpin	*Cottus cognatus*	IV	c	Aquatic	Spring fed cold water streams	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Smallmouth redhorse	*Moxostoma breviceps*	IV	b	Aquatic	Large rivers with swift flows and gravel to boulder substrates.	This species is newly recognized, formerly considered to part of the shorthead redhorse population. This species is restricted to the Tennessee River drainage where it occurs in low densities and is considered to be extirpated from the North Fork Holston. Research is needed to determine if this species could be reintroduced to the North Fork Holston River. The need and effectiveness of this reintroduction effort would benefit additional status surveys, distribution surveys, habitat modeling, and population monitoring. This species will be prioritized as Tier 4b. This status will be reconsidered as these research needs are addressed.
Fish	Snail bullhead	*Ameiurus brunneus*	III	c	Aquatic	Well flowing streams and rivers with rocky substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.
Fish	Speckled darter	*Etheostoma stigmaeum*	IV	c	Aquatic	Clear sandy and rocky pools of creeks and small to medium rivers with moderate gradient and fast water, occasionally sluggish murky streams	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Speckled killifish	*Fundulus rathbuni*	IV	c	Aquatic	Slow moving streams and creeks with sandy substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Spotfin chub	*Erimonax monachus*	I	b	Aquatic	Clean medium sized streams and rivers with clean gravel and cobble substrate	Research is needed to determine if this species would be a candidate for captive propagation and reintroduction. Additional habitat and distribution surveys are also required for the Clinch River. This species will be prioritized as Tier 1b. This status will be reconsidered when these research needs are addressed.
Fish	Steelcolor shiner	*Cyprinella whipplei*	III	c	Aquatic	Warm low to moderate gradient streams and rivers over a variety of substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Stonecat	*Noturus flavus*	IV	c	Aquatic	Warm streams and rivers with moderate to low gradient with rocky substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Suckermouth minnow	*Phenacobius mirabilis*	IV	c	Aquatic	Warm, clear to turbid streams and rivers with moderate gradient with sand and gravel substrate	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Swannanoa darter	*Etheostoma swannanoa*	IV	b	Aquatic	Cool clear streams with moderate to high gradient with clean gravel, rubble, and boulder substrates	Research is needed to determine if this species could be reintroduced into suitable habitats. Research is also needed to determine how this species might be impacted by climate change. This species will be prioritized as Tier 4b. This status will be reconsidered as these research needs are addressed.
Fish	Tadpole Madtom	*Noturus gyrinus*	IV	c	Aquatic	Quiet or slow-moving waters, especially over soft muddy bottom with extensive vegetation; lakes, reservoirs, sloughs, swamps, backwaters, lowland creeks and small to large rivers	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Tangerine darter	*Percina aurantiaca*	IV	c	Aquatic	Clean, cool and warm streams and rivers with moderate gradient and a variety of substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Tennessee dace	*Chrosomus tennesseensis*	I	b	Aquatic	Clean creeks with rock, gravel, or silt substrates and stable banks	This species would benefit from the creation of a recovery plan. Additional information regarding is distribution and habitat needs would also be beneficial. This species will be prioritized as Tier 1b. This status will be reconsidered when the planning and research needs are addressed.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Tonguetied Minnow	*Exoglossum laurae*	IV	c	Aquatic	Rocky pools and runs of cool to warm, usually clear, creeks and small to medium rivers of moderate gradient, generally with relatively unsilted bottoms of gravel, rubble, and boulder, often at deeper edges of pools near vegetation or other cover	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Variegate darter	*Etheostoma variatum*	I	a	Aquatic	Warm to cool water streams with clean gravel, rubble, or boulder substrates	This species has one stable population in the Levisa Fork of the Big Sandy drainage. This species would benefit from efforts to improve water quality. This need is consistent with action plan priorities to conserve and restore aquatic habitats and improve water quality. This species would also benefit from the creation of a conservation plan. Research is also needed to determine if this species would be a candidate for reintroduction efforts in the Russel Fork. Population and habitat modeling would advance these efforts. This species will be prioritized as Tier 1a.
Fish	Western sand darter	*Ammocrypta clara*	IV	c	Aquatic	Warm, low and moderate gradient rivers with sand and sand-gravel substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 4c.
Fish	Whitemouth shiner	*Notropis alborus*	II	c	Aquatic	Clear to somewhat turbid creeks, with varying substrates	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 2c.
Fish	Wounded darter	*Etheostoma vulneratum*	III	c	Aquatic	Warm moderate gradient streams and rivers with clean gravel and rubble substrate	Baseline information is required to better understand this species' habitat requirements. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Fish	Yellowfin madtom	*Noturus flavipinnis*	I	a	Aquatic	Warm, clear streams and rivers with moderate gradient and variety of cover types	Efforts to reintroduce this species into the Northfork Holston River should continue. Efforts to monitor the success of this reintroduction and the status of existing populations and habitats should also continue. This species will be prioritized as Tier 1a.
Mammals	Allegheny woodrat	*Neotoma magister*	IV	a	Barren	Blue Ridge to the west - riparian areas, wooded wetlands, caves and cliffs	The two main threats to this species are parasitism and habitat destruction. Research is needed to evaluate parasite epidemiology. The USFS and others currently work to maintain occupied habitats. This species will be prioritized as Tier 4a.
Mammals	Appalachian cottontail	*Sylvilagus obscurus*	IV	a	Forest	High elevation forested areas west of the Shenandoah River	The primary threats to this species involve the loss of young forest habitats and competition from eastern cottontails. Efforts to create patches of young forest habitat are consistent with other action plan priorities. This species will be prioritized as Tier 4a.
Mammals	Atlantic bottlenose dolphin	*Tursiops truncatus*	III	b	Aquatic	Offshore form frequents pelagic waters. Coastal form usually shoreward of 20 m contour, often in lagoons, bays, river mouths; ascends river in some areas; common near passes connecting large bays with ocean	The population of this species in Virginia waters is considered to be "depleted" by NOAA under the Marine Mammal Protection Act. Currently, no management strategies have been identified for this species in Virginia waters. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. Once completed, the management category for this species will be updated. The marine mammal plan will serve as a companion document to the Action Plan and will be used to drive conservation efforts for this species. This species will be prioritized as Tier 3b. This ranking will be reconsidered when this planning need has been addressed.
Mammals	Carolina northern flying squirrel	*Glaucomys sabrinus coloratus*	I	c	Forest	Cool moist mature coniferous and mixed forests with abundant standing and down snags	This species' recovery plan needs to be updated to ensure that modern threats, research needs, and conservation actions are adequately understood. This species will be prioritized as Tier 4b. This status will be reconsidered when this planning need has been addressed.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Cotton mouse	*Peromyscus gossypinus gossypinus*	IV	a	Forest	Riparian forests	The main threats to this species include habitat destruction, hydrologic regime alteration, and competition. Efforts to conserve and restore aquatic and wetland habitats are consistent with other action plan priorities. This species will be prioritized as Tier 4a.
Mammals	Delmarva fox squirrel	*Sciurus niger cinereus*	II	c	Forest	Mature pine and hardwood forests with open understories	During September 2014, the USFWS proposed removing the Delmarva Fox Squirrel from the Federal list of endangered species. It was determined that conservation actions and habitat restoration had successfully ameloriated threats to this species' survival. This species remains rare in Virginia, but no additional conservation actions have been identified. This species will be prioritized as Tier 2c.
Mammals	Eastern small-footed myotis	*Myotis leibii*	I	a	Barren	Hibernation occurs in solution and fissure caves and mine tunnels (including coal, iron, copper, and talc mines). Situations near the entrance where the air is relatively cold and dry seem to be preferred, though sometimes deeper locations are used. Roost sites often are deep in crevices, or under rocks on the cave floor. Forages over ponds and streams.	This species has been significantly affected by white-nosed syndrome. No management actions have been identified to address this disease. Other threats include human disturbance of hibernacula from recreational use. Winter caving should be discouraged and high priority caves should be gated to prevent human use during vulnerable times. The USFS works to conserve known habitats. This species will be prioritized as Tier 1a.
Mammals	Eastern spotted skunk	*Spilogale putorius putorius*	IV	c	Barren	Blue Ridge to the west - rock piles, rock slides and cliffs surrounded by forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Fin whale	*Balaenoptera physalus*	IV	b	Aquatic	Pelagic	This is the most common large whale in Virginia waters and is listed as endangered under the Federal Endangered Species Act. Management strategies for this species are dated and do not include increasing pressures related to shipping and energy development. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. Once completed, the management category for this species will be updated. The marine mammal plan will serve as a companion document to the Action Plan and will be used to drive conservation efforts for this species. This species will be prioritized as Tier 4b. This ranking will be reconsidered when the planning need has been addressed.
Mammals	Fisher	*Martes pennanti pennanti*	IV	c	Forest	Spruce-fir forests, northern bogs and swamps, or mixed northern hardwood forests	Although populations are limited, this species appears to be more widely distributed than previously thought. Its mature forest habitats are not in limited. This species will be prioritized as Tier 4c.
Mammals	Gray bat	*Myotis grisescens*	II	a	Cave/Karst	Winter roosts are in deep vertical caves with domed halls. Large summer colonies utilize caves that trap warm air and provide restricted rooms or domed ceilings; maternity caves often have a stream flowing through them and are separate from the caves used in summer by males. Forage along steams flowing through forested areas.	The most significant threats to gray bats involve human disturbance in hibernacula. Other threats involve loss of riparian vegetation in foraging areas and removal of trees from areas around cave entrances. Coservation actions include gating entrances to to known caves, maintaining healthy riparian forests, and retaining vegetated buffers around cave entrances. This species will be prioritized as Tier 2a

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Harbor porpoise	*Phocoena phocoena*	IV	c	Aquatic	Coastal waters and adjacent offshore shallows; also inhabits inshore areas such as bays, channels, and rivers	The population of this species in Virginia waters is considered to be "depleted" by NOAA under the Marine Mammal Protection Act. Currently, no management strategies have been identified for this species in Virginia waters however biologists are concerned populations in Virginia waters are impacted by fishing nets and other gear. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. Once completed, the management category for this species will be updated. The marine mammal plan will serve as a companion document to the Action Plan and will be used to drive conservation efforts for this species. This species will be prioritized as Tier 4b. This ranking will be reconsidered when the planning need has been addressed.
Mammals	Hoary Bat	*Lasiurus cinereus*	IV	a	Forest	Primarily deciduous and coniferous forests and woodlands, including areas altered by humans	Populations of this speies in other parts of the country have been significantly impacted by wind energy development. Due to the economic downturn, development of wind energy facilities has been limited. However, as the economy improves, wind energy development is expected to increase. Two actions that can be taken to address this threat and three specific research questions that should be answered to enhance protection efforts. Conservation actions include: Environmental commenting related to the siting of wind energy facilities and working with wind energy companies to modify their operations during the fall migration period. Research needs include: assessing the coastal migration patterns of bats, assessing current population status and trends for tree-dwelling bats, determine why bats are attracted to wind turbines so that deterrents may be developed. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Humpback whale	*Megaptera novaengliane*	I	b	Aquatic	Open ocean and coastal waters, sometimes including inshore areas such as bays	This species is listed as endangered under the Federal Endangered Species Act and individuals of this species occur in Virginia waters seasonally. Management strategies for this species are dated and do not address increasing pressures related to shipping and energy development. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. This species will be prioritized as Tier 1b. This status will be reconsidered when this planning need has been addressed.
Mammals	Indiana myotis	*Myotis sodalis*	I	a	Forest	West of Shenandoah River - winter site specific caves, summer forested areas containing dead exfoliating trees.	The primary threats to this species are unintentional kills from power generation and human interactions. Additional threats include collapse of hibernacula, destruction of riparian areas, and (potentially) pesticide poisoning. Protecting hibernacula and working to conserve and restore riparian areas are consistent with action plan priorities. Management actions include: prevent disturbance to hibernacula; protect, maintain, and restore foraging and nursery areas; and carry out a public information campaign. Research needs from the recovery plan include monitoring of summer and hibernacula population trends, monitoring levels of toxins and researching their effects, and research on summer habitat requirements. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Little Brown Bat	*Myotis lucifugus*	I	a	Multiple	Wide range of habitats and often use human-made structures for resting and maternity sites; they also use caves and hollow trees	Populations of this species have been dramatically reduced by white-nose syndrome. While agencies are not currently able to address white-nose syndrome, several management actions can be taken to help preserve existing populations. Actions include: protecting hibernacula via gating, purchase, or easement; protecting fall swarm roosts and foraging areas; developing a certification for Wildlife Control Operators that exclude bats from dwellings; Environmental commenting related to the siting of wind energy facilities. Specific research needs have also been identified to address specific threats. Research needs involve determining the productivity and survivorship at maternity colonies as a means of evaluating the success of conservation actions. This species will be prioritized as Tier 1a.
Mammals	Long-tailed shrew	*Sorex dispar dispar*	IV	c	Forest	West of Shenandoah talus slopes, rock slides and cliffs surrounded by forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Mammals	Marsh rabbit	*Sylvilagus palustris palustris*	IV	a	Wetland	Freshwater wetlands	The primary threats to this species are habitat destruction from and competition from eastern cottontails. Efforts to conserve freshwater wetland habitats are consistent with other Action Plan priorities. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Northern Long-Eared bat	*Myotis septentrionalis*	I	a	Forest	Hibernate in caves and mines. Mature forests for summer roosts and feeding.	Populations of this species have been dramatically reduced by white-nose syndrome. While agencies are not currently able to address white-nose syndrome, several management actions can be taken to help preserve existing populations. Actions include: protecting hibernacula via gating, purchase, or easement; protecting fall swarm roosts and foraging areas; developing a certification for Wildlife Control Operators that exclude bats from dwellings; Environmental commenting related to the siting of wind energy facilities. Specific research needs have also been identified to address specific threats. Research needs involve determining the productivity and survivorship at maternity colonies as a means of evaluating the success of conservation actions. This species will be prioritized as Tier 1a.
Mammals	Northern right whale	*Eubalaena glacialis*	I	b	Aquatic	Nearshore and offshore waters	This species is listed as endangered under the Federal Endangered Species Act and Virginia's coastal waters are believed to serve as an important migratory corridor. Management strategies for this species are dated and do not include increasing pressures related to shipping and energy development. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. This species will be prioritized as Tier 1b. This status will be reconsidered when this planning need is addressed.
Mammals	Pungo white-footed mouse	*Peromyscus leucopus easti*	III	c	Barren	Coastal marshes and dunes	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Rafinesque's eastern big-eared bat	*Corynorhinus rafinesquii macrotis*	I	a	Forest	Use hollow trees as well as various types of human structures for roosting	The main threats to this species include the loss of bottomland forest containing suitable roost trees and the decline in the number of abandoned buildings in the region. This species is very sensitive to disturbance. Additional threats include disturbance related to forestry, toxins, insecticides, and metals. Priority management actions include long-term forest management to allow forests to age, for roost trees, to occur; maintenance, preservation, and creation of abandoned buildings and alternative roost sites in likely areas; and reduction or elimination of heavy metals and pesticide contamination. Actions to restore large patches of mature forest in the eastern portions of Virginia are consistent with action plan priorities. Research needs include extensive surveys to locate maternity colonies; possible effects of wind turbines on this species; and the extent and effects of insecticide contamination and bioaccumulation in wild populations. This species will be prioritized as Tier 1a.
Mammals	Red Bat (proposed for inclusion)	*Lasiurus borealis*	IV	a	Forest	Wide range of forested and semi-forested areas, including developed areas with large trees (e.g., city parks) and some areas subject to intensive forest management	Populations of this species in other parts of the country have been significantly impacted by wind energy development. Due to the economic downturn, development of wind energy facilities has been limited. However, as the economy improves, wind energy development is expected to increase. This proposal identifies two actions that can be taken to address this threat, and three specific research questions that should be answered to enhance protection efforts. Conservation actions include: Environmental commenting related to the siting of wind energy facilities and working with wind energy companies to modify their operations during the fall migration period. Research needs include: assessing the coastal migration patterns of bats, assessing current population status and trends for tree-dwelling bats, determine why bats are attracted to wind turbines so that deterrents may be developed. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Silver-haired Bat (proposed for inclusion)	*Lasionycteris noctivagans*	IV	a	Forest	Forested (frequently coniferous) areas adjacent to lakes, ponds, or streams, including areas that have been altered by humans	Populations of this speies in other parts of the country have been significantly impacted by wind energy development. Due to the economic downturn, development of wind energy facilities has been limited. However, as the economy improves, wind energy development is expected to increase. This proposal identifies two actions that can be taken to address this threat, and three specific research questions that should be answered to enhance protection efforts. Conservation actions include: Environmental commenting related to the siting of wind energy facilities and working with wind energy companies to modify their operations during the fall migration period. Research needs include: assessing the coastal migration patterns of bats, assessing current population status and trends for tree-dwelling bats, determine why bats are attracted to wind turbines so that deterrents may be developed. This species will be prioritized as Tier 4a.
Mammals	Snowshoe hare	*Lepus americanus virginianus*	I	c	Forest	Specific spruce/fir sites in Highland county that provide sufficient cover	This species is impacted by the loss of habitat from natural succession and climatic changes. The species is currently limited to areas that support red spruce, which is in significant decline in Virginia and could be extirpated by changing climatic conditions. This species may benefit from efforts to create young forest habitat, but more specific actions have not been identified. The priority management action is timber harvest, preferably heavy thinning, is desperately needed to open the overstory and promote understory growth in these areas. Research is needed to determine if this species would benefit from the creation of young forest patches. This species will be prioritized as Tier 1b. This ranking will be reconsidered when this research need has been addressed.
Mammals	Southeastern fox squirrel	*Sciurus niger niger*	III	a	Forest	Open mature stands of pine or pine/hardwoods	Habitat loss is the greatest threat to this species. The conservation of large stands of mature oak/pine forests are consistent with forest priorities identified within the action plan. This species will be prioritized as Tier 3a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Southeastern myotis	*Myotis austroriparius*	IV	a	Forest	Riparian forests with suitable roost structures	The primary threats to this species appear to be the loss of roost sites and wooded wetland habitats. The conservation and restoration of wooded wetlands is consistent with other action plan priorities. This species will be prioritized as Tier 4a.
Mammals	Southern rock vole	*Microtus chrotorrhinus*	II	a	Forest	High elevation talus and riparian areas	This species is most threatened by the loss of forests that might allow their talus habitats to dry out. This species benefits from efforts to maintain high elevation forests in cool, moist talus areas. The USFS implements efforts to ensure that high elevation oak forests and high elevation pine forests and woodlands are maintained and managed to both preserve and connect existing habitats. This species will be prioritized as Tier 2a.
Mammals	Southern water shrew	*Sorex palustris*	II	a	Forest	High elevation riparian areas in Bath and Highland counties	This species is most threatened by the loss or degradation of high elevation riparian forests. The needs of this species are consistent with action plan priorities to maintain or restore riparian forests and improve water quality. This species will be prioritized as Tier 2a.
Mammals	Tri-colored Bat	*Perimyotis subflavus*	I	a	Forest	Forested landscapes, where they forage near trees (including forest perimeters) and along waterways	Populations of this species have been dramatically reduced by white-nose syndrome. While agencies are not currently able to address white-nose syndrome, several management actions can be taken to help preserve existing populations. Actions include: protecting hibernacula via gating, purchase, or easement; protecting fall swarm roosts and foraging areas; Environmental commenting related to the siting of wind energy facilities. Specific research needs have also been identified to address specific threats. Research needs involve determining the productivity and survivorship at maternity colonies as a means of evaluating the success of conservation actions, and collecting basic life history data for this species. This species will be prioritized as Tier 1a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	Virginia big-eared bat	*Corynorhinus townsendii virginianus*	II	a	Open vegetated	Caves typically in limestone karst regions dominated by mature hardwood forests of hickory, beech, maple, and hemlock. Prefers cool, well-ventilated caves for hibernation; roost sites are often near cave entrances or in places where there is considerable air movement.	The primary threats to this species include are human disturbance of hibernacula from recreational use of habitat and unintentional capture or killing from power generation. Winter caving should be discouraged and high priority caves should be gated to prevent human use during vulnerable times. This species will be prioritized as Tier 2a.
Mammals	Virginia northern flying squirrel	*Glaucomys sabrinus fuscus*	I	a	Forest	Spruce -fir and mixed conifer-northern hardwood forests	In 2008, the US Fish and Wildlife Service determined this species had responded to conservation and habitat restoration effort. The US Fish and Wildlife Service proposed removing this species from the list of endangered species. Later in 2008, the delisting decision was vacated by the court. In March 2013 USFWS moved to reinstate removal. Efforts to manage this species' habitat in Virginia are ongoing and consistent with strategies identified within the post-listing plan. Given this species limited distribution in Virginia, it will always be at a high risk of extirpation. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Mammals	West Indian manatee	*Trichechus manatus latirostris*	IV	b	Aquatic	Shallow coastal waters, estuaries, bays, rivers, and lakes	This species is listed as Endangered per the Federal Endangered Species Act. Although uncommon, manatees are appearing more frequently in Virginia waters where they face a number of anthropogenic hazards. Currently, no management strategies have been identified for this species in Virginia waters. DGIF staff and partners expect to complete a Virginia Marine Mammal Conservation Plan either in late 2016 or early 2017. Once completed, the management category for this species will be updated. The marine mammal plan will serve as a companion document to the Action Plan and will be used to drive conservation efforts for this species. This species will be prioritized as Tier 4b. This ranking will be reconsidered when the planning need has been addressed.
Other Aq Insects	A branchiobdelid worm	*Ankyrodrilus legacus*	IV	c	Cave/Karst	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Aq Insects	A cave lumbriculid worm	*Stylodrilus beattiei*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	This species only occurs in Steele's Cave in Tazwell County. Potential stresses include water pollution and alteration of groundwater. No management actions have been identified. Research needs include understanding natural history and distribution. This species will be prioritized as Tier 1c.
Other Aq Insects	A cave lumbriculid worm	*Spelaedrilus multiporus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Aq Insects	A cave obligate worm	*Cambarincola fallax*	IV	c	Cave/Karst	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Aq Insects	A cave planarian	*Geocentrophora cavernicola*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Aq Insects	A groundwater planarian	*Procotyla typhlops*	I	c	Groundwater	Spring/ spring brook	This species has never been observed in the state but is anticipated to occur Virginia. Potential stresses include water pollution and alteration to groundwater. No management actions have been identified. Research needs include collecting information on life history and distribution as well as determining if it actually occurs in the state. This species will be prioritized as Tier 1c.
Other Aq Insects	A groundwater planarian	*Sphalloplana hypogea*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Aq Insects	Bigger's groundwater planarian	*Sphalloplana subtilis*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Aq Insects	Chandler's planarian	*Sphalloplana chandleri*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	This species only occurs in Fallen Rock cave in Tazwell county. Potential stresses include groundwater pollution and stream alteration. No management actions have been identified. Research needs include understanding information on natural history and distribution. This species will be prioritized as Tier 1c.
Other Aq Insects	Holsinger's groundwater planarian	*Sphalloplana holsingeri*	II	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Aq Insects	Powell Valley planarian	*Sphalloplana consimilis*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	This species is endemic to a portion of Powell Valley. No specific threats have been identified however water pollution could be a threat. This species will be prioritized as Tier 1c.
Other Aq Insects	Rockbridge County cave planarian	*Sphalloplana virginiana*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	This species only occurs in Showalters Cave in Rockbridge County. Potential stresses include water pollution and alteration to groundwater. No management actions have been identified. Research needs include understanding information on natural history and distribution. This species will be prioritized as Tier 1c.
Other Terr Inverts	A cave centipede	*Nampabius turbator*	III	c	Cave/Karst	Subterranean obligate	This species is the only cave adapted centipede in Virginia. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A cave pseudoscorpion	*Kleptochthonius anophthalmus*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Kleptochthonius binoculatus*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Kleptochthonius proximosetus*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Kleptochthonius regulus*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Kleptochthonius similis*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Mundochthonius holsingeri*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	A cave pseudoscorpion	*Chitrella cavicola*	III	b	Unknown	Unknown	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 3b. This ranking will be reconsidered when this research need has been addressed.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A cave spider	*Islandiana muma*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A cave spider	*Anthrobia mammouthia*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A cave spider	*Bathyphantes weyeri*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A centipede	*Escaryus ethopus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A funnel-web spider	*Barronopsis jeffersi*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A gnaphosid spider	*Gnaphosa fontinalis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A gnaphosid spider	*Drassyllus louisianus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Aniulus orientalis*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Auturus erythropygos*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Brachoria dentata*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Brachoria insolita*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A millipede	*Buotus carolinus*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Cleidogona lachesis*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Dixioria fowleri*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Nannaria simplex*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Pseudotremia alecto*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Pseudotremia armesi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Pseudotremia momus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Pseudotremia sublevis*	II	c	Cave/Karst	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Pseudotremia tuberculata*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Striaria causeyae*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Striaria columbiana*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A millipede	*Striaria granulosa*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Trichopetalum dux*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	A millipede	*Brachoria separanda calcaria*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Brachoria separanda hamata*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Brachoria separanda versicolor*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Dixioria coronata*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Pseudopolydes mus paludicolous*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Semionellus placidus*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Uroblaniulus jerseyi*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	A millipede	*Abacion tessalatum*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Apheloria virginiensis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A millipede	*Boraria infesta*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Brachoria separanda*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Chaetaspis albus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Cherokia georgiana latassa*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Desmonus earlei*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Euryurus leachi fraternus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Gyalostethus monticolens*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Nannaria wilsoni*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Okeanobates americanus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Onomeris underwoodi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Orinisobates nigrior*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A millipede	*Petaserpes rosalbus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Petaserpes strictus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Pseudotremia valga*	IV	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Rudiloria kleinpeteri*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Scytonotus virginicus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Thalassisobates littoralis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Trichomeris sinuata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Trichopetalum lunatum*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Uroblaniulus canadensis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Virgoiulus minutus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A millipede	*Rudiloria trimaculata tortua*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	A nursery-web spider	*Pisaurina dubia*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A two-clawed hunting spider	*Castianeira trilineata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A two-clawed hunting spider	*Clubiona spiralis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	A wolf spider	*Lycosa lenta*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Aeto millipede	*Conotyla aeto*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	An amaurobiid spider	*Amaurobius borealis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Appalachia bellytooth	*Gastrodonta fonticula*	III	c	Unknown	Forest/Woodland, Savanna, Shrubland, Suburban/orchard, Urban/edificarian, Conifer, Hardwood, Mixed	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Atlantic purse-web spider	*Sphodros atlanticus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Baffled three-tooth	*Triodopsis fradulenta*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Balsam globe	*Mesodon andrewsae*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Barred supercoil	*Paravitrea seradens*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Bidentate dome	*Ventridens coelaxis*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Big Cedar Creek millipede	*Brachoria falcifera*	II	c	Rock ledges	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Black mantleslug	*Pallifera hemphilli*	II	c	Forest	Spruce-fir forests above 5000 feet and most frequently found during wet weather	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Black Mountain disc	*Discus nigrimontanus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Black purse-web spider	*Sphodros niger*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Blotchy mantleslug	*Megapallifera wetherbyi*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Blowing Rock millipede	*Cleidogona medialis*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Bluegrass snaggletooth	*Gastrocopta clappi*	III	c	Unknown	Under rocks, around the base of grass tufts, and under sparse vegetation on xeric glades and grasslands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Brilliant glyph	*Glyphyalinia praecox*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Brooks millipede	*Dixioria brooksi*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Brown globelet	*Inflectarius kalmianus*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Brown supercoil	*Paravitrea septadens*	I	c	Forest	Deep moist leaf litter on wooded hillsides at the base of hills and ravines	This species is endemic to Dickenson and Buchanana counties. The only known threats include the reduction of leaf litter. No management actions have been identified. The only research need included is to survey for additional populations. This species will be prioritized sa Tier 1c.
Other Terr Inverts	Budded three-tooth	*Triodopsis tennesseensis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Buttressed threetooth	*Triodopsis rugosa*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Carinate slitmouth	*Stenotrema spinosum*	III	c	Unknown	Rotting logs in woods	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Carolina scorpion	*Vaejovis carolinianus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Carter threetooth	*Triodopsis anteridon*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Cave pseudoscorpion	*Apochthonius coecus*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Cave pseudoscorpion	*Apochthonius holsingeri*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Cave pseudoscorpion	*Chitrella superba*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Cedar millipede	*Brachoria cedra*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Celeno millipede	*Conotyla celeno*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Cherrystone drop	*Hendersonia occulta*	IV	c	Unknown	Algific talus slopes; cool, shaded talus	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Clingman covert	*Fumonelix wheatleyi*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Collinwood millipede	*Brachoria mendota*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Comb supercoil	*Paravitrea dentilla*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Coyle's purse-web spider	*Sphodros coylei*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Crablike spiny orb weaver	*Gasteracantha cancriformis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Cumberland liptooth	*Millerelix plicata*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Cupped vertigo	*Vertigo clappi*	III	c	Unknown	Well-decomposed leaf litter and fine soil on shaded boulders, talus, ledges and bases of forested bedrock outcrops	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Delicate vertigo	*Vertigo bollesiana*	II	c	Unknown	Leaf litter on wooded hill sides and marshes	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Depressed glyph	*Glyphyalinia virginica*	III	c	Aquatic	No habitats have been identified for this terrestrial snail	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Duke Forest xystodesmid millipede	*Nannaria conservata*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Ellett Valley Pseudotremia millipede	*Pseudotremia cavernarum*	I	c	Cave/Karst	Subterranean obligate	This species has a very limited range and this habitat is threatened by suburban development. Efforts can be made to work with willing landowners to conserve this habitat via acquisition, easement, or agreement. This species will be prioritized as Tier 1a.
Other Terr Inverts	Emerton's crab spider	*Xysticus emertoni*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Faithful millipede	*Cleidogona fidelitor*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Fine-ribbed striate	*Striatura milium*	IV	c	Forest	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Five-tooth vertigo	*Vertigo ventricosa*	III	c	Unknown	Humid, well-decomposed graminoid and broadleaf plant litter in moderately to highly acidic wooded and open wetlands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Flat button	*Mesomphix subplanus*	III	c	Forest	Forested areas above 2000 feet with downed logs and moist leaf litter	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Funnel supercoil	*Paravitrea mira*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Gertsch's lampshade-web spider	*Hypochilus gertschi*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Gertsch's cave pseudoscorpion	*Kleptochthonius gertschi*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Glassy grapeskin	*Vitrinizonites latissimus*	IV	c	Unknown	Leaf litter or crawling on the ground in wet weather usually above 2000 feet in the mountains, but may occur below 1000 feet in the outlying hills	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Glossy supercoil	*Paravitrea placentula*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Golden dome	*Ventridens arcellus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Hanging Rock threetooth	*Triodopsis pendula*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Highland slitmouth	*Stenotrema altispira*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Hoffman's cleidogonid millipede	*Cleidogona hoffmani*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Hoffman's xystodesmid millipede	*Brachoria hoffmani*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Hollow dome	*Ventridens lasmodon*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Hungry mother millipede	*Brachoria ethotela*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Keeton's millipede	*Brachoria laminata*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Laurel Creek xystodesmid millipede	*Sigmoria whiteheadi*	I	c	Aquatic	Known from one location where it occurs under leaf litter of rhododendrons and hardwoods within 5 meters of stream.	This species has only been observed at one location, near the headwaters of Laurel Creek in Floyd County. No threats are included for this species. As it occurs in land owned by NPS, the only management action is to continue to protect this land. Research needs include surveys and surveys for likely habitat. This species will be prioritized as Tier 1c.
Other Terr Inverts	Lowland pillsnail	*Euchemotrema leai*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Lutz's cave pseudoscorpion	*Kleptochthonius lutzi*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Maryland glyph	*Glyphyalinia raderi*	II	c	Forest	Calciphile and a burrower that lives in forest leaf litter	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	McGraw Gap xystodesmid millipede	*Nannaria ericaea*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Melinda millipede	*Conotyla melinda*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Montane centipede	*Escaryus cryptorobius*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Mountain disc	*Anguispira jessica*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Natural Bridge supercoil	*Paravitrea pontis*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Ovate vertigo snail	*Vertigo ovata*	IV	c	Unknown	Raminoid litter and on cattail leaves in swamps, sedge meadows, wet and mesic prairie, low calcareous meadows, river banks, lakeshores, roadside ditches, and wooded wetlands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Palmetto vertigo	*Vertigo oralis*	IV	c	Unknown	Broadleaf and graminoid leaf litter accumulations, and under logs, in wet woodlands including pool margins in oak-sweetgum forest, red maple swamp, cypress swamp, and riparian and pocosin scrub	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Pinhole threetooth	*Triodopsis messana*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Pittsylvania three-tooth	*Triodopsis burchi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Pocock's lampshade-web spider	*Hypochilus pococki*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Proud globe snail	*Mesodon elevatus*	IV	c	Forest	Calcareous river bluffs and ravines with oak, maple, hickory, or sycamore	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Red-legged purse-web spider	*Sphodros rufipes*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Ribbed striate	*Striatura exigua*	IV	c	Forest	No habitats have been identified for this terrestrial snail	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Robust trapdoor spider	*Antrodiaetus robustus*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Round supercoil	*Paravitrea reesei*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Rounded dome	*Ventridens lawae*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Rubble coil	*Helicodiscus lirellus*	I	a	Barren	Known from two rubble piles at the bases of two hills in Rockbridge county.	This species is endemic to a small portion of the Ridge and Valley ecoregion. The only known threat involves the disturbance of slopes where the species is found. The primary management action is to protect the hills where found. The only research need included is to conduct more surveys near the location of current populations. This species will be prioritized as Tier 1a..
Other Terr Inverts	Rust glyph	*Glyphyalinia picea*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Shaggy coil	*Helicodiscus diadema*	I	c	Open vegetated	Known from four locations and occupies leaf litter at the base of limestone/shale outcropings.	This species is endemic to the Ridge and Valley. Threats listed include: disturbance to the rock, trees around leaf litter, or the leaf litter itself. No management actions are included. The only research need included is to survey near the known populations to try to identify additional populations. This species will be prioritized as Tier 1c.
Other Terr Inverts	Shenandoah Mountain xystodesmid millipede	*Nannaria shenandoah*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Shenandoah pseudoscorpion	*Kleptochthonius polychaetus*	III	b	Unknown	Unknown	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 3b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Shrew supercoil	*Paravitrea blarina*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Slender supercoil	*Paravitrea subtilis*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Slim snaggletooth	*Gastrocopta pellucida*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Smallmouth vertigo	*Vertigo parvula*	III	c	Unknown	Limestone substrata, low elevation, steep slopes, neutral soils and leaf litter microhabitat	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Smith Creek xystodesmid millipede	*Nannaria laminata*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Smooth bladetooth	*Patera laevior*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Snowhill ambersnail	*Catinella hubrichti*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	South Branch Valley cave millipede	*Pseudotremia princeps*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Southeastern wandering spider	*Anahita punctulata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Spirit supercoil	*Paravitrea hera*	I	a	Forest	Site specific - inhabits leaf litter on specific river bluffs in Pittsylvania county	This species only occurs in Pittsylvania County. Logging in the wooded bluffs where this species occurs is the only known threat. The primary management action is to work with willing landowners to protect these wooded bluffs from logging and disturbance. Research needs include surveys as this species is only known from its shells. This species will be prioritized as Tier1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Spruce Knob threetooth	*Triodopsis picea*	II	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Suborb glyph	*Glyphyalinia sculptilis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Swamp vertigo	*Vertigo teskeyae*	IV	c	Unknown	Open mud and water-saturated logs in floodplain forests and along river, pond, and lake shores following water level drawdown in mid to late summer	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Talus coil	*Helicodiscus triodus*	II	c	Barren	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Temperate coil	*Helicodiscus shimeki*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Thorell's lampshade-web spider	*Hypochilus thorelli*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Tiny liptooth	*Lobosculum pustuloides*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Trumpet vallonia	*Vallonia parvula*	IV	c	Unknown	Calcareous cliff, alvar, grassland and upland forest	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Turner's millipede	*Brachoria turneri*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Other Terr Inverts	Twilight coil	*Helicodiscus multidens*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Valentine's cave pseudoscorpion	*Microcreagris valentinei*	II	b	Cave/Karst	Caves with clean abundant water flowing through the system.	This species degree of endemism has been called into question. Research to determine if it is a unique species or part of a larger metapopulation would be useful. This species will be prioritized as Tier 2b. This ranking will be reconsidered when this research need has been addressed.
Other Terr Inverts	Variable mantleslug	*Pallifera varia*	III	c	Forest	Moist forest habitats	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Venetia millipede	*Conotyla venetia*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Virginia bladetooth	*Patera panselenus*	III	c	Terrestrial	Exposed rock outcrops and talus within mature forest, usually on steep (15-30 degree) slopes at elevations from 340-490 m; usually on nearly vertical rock surfaces or the underside of rock (mostly sandstone but also shale and limestone) overhangs	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Virginia fringed mountain snail	*Polygyriscus virginianus*	I	a	Forest	Leaf litter but burrows in loose, damp, dolomitic limestone talus mixed with rootlets and clay	Recent surveys conducted by the US Fish and Wildlife Service indicate this species has a larger distribution than previously thought. The two most significant threats to this species are disturbance/destruction of the narrow habitat area and climate change. Efforts should be made to work with willing landowners to conserve the occupied habitat via acquisition, easement, or agreement. This species will

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
							be prioritized as Tier 1a.
Other Terr Inverts	Virginia mantleslug	*Philomycus virginicus*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Other Terr Inverts	Whitetop Mountain centipede	*Escaryus orestes*	II	c	Unknown	No habitats have been identified for this species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Other Terr Inverts	Widespread column	*Pupilla muscorum*	IV	c	Unknown	Disturbed anthropogenic habitats such as road verges, vacant lots, abandoned quarries, old fields, and concrete culverts, occasionally inhabit less disturbed carbonate cliff, glade, and grassland sites	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Wrinkled button	*Mesomphix rugeli*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Yellow dome	*Ventridens pilsbryi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Other Terr Inverts	Yellow globelet snail	*Mesodon clausus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Bog turtle	*Clemmys muhlenbergii*	I	a	Wetland	Emergent wetlands with dense vegetation	The original wildlife action plan indicated this species would benefit from more rigorous enforcement of collection laws and efforts to conserve/restore wetland habitats used by this species. This species will be prioritized as Tier 1a.
Reptiles	Canebrake rattlesnake	*Crotalus horridus (canebrake)*	II	a	Barren	#N/A	Virginia's Canebrake Rattlesnake recovery plan was completed in 2011. This document identifies 7 management actions and research needs for this species. These include conserving and restoring occupied habitats, enforcing laws to preclude take, monitoring known populations and looking for new populations, researching the species' life history, working to conserve or restore large forest patches in occupied areas, developing outreach materials, and researching translocation and artificial hibernation as a potential recovery tool.
Reptiles	Common ribbonsnake	*Thamnophis sauritus sauritus*	IV	a	Wetland	Permanent ponds, marshes, streams, and rivers, east of the Shenandoah river, with vegetated shorelines and amphibian and small fish populations	The needs of this species are consistent with priorities to conserve and restore wetland habitats. This species will be prioritized as Tier 4a.
Reptiles	Common snapping Turtle	*Chelydra serpentina*	IV	b	Aquatic	Ponds, lakes, streams, rivers, swamps, freshwater marshes, and brackish marshes.	Virginia's snapping turtle populations have become the target of commercial harvesters. Harvested animals are either processed for human consumption or shipped to Asia for propagation purposes. It is unclear if this level of harvest is sustainable. DGIF has initiated research to determine if populations are being impacted by these commercial activities and what management or regulatory changes should be made to conserve this species. This species will be prioritized as Tier 4b. This ranking will be reconsidered when research needs have been addressed.
Reptiles	Cumberland slider	*Trachemys scripta troostii*	III	c	Aquatic	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches	Additional information regarding this species' distribution and life history are required before other research or conservation needs can be identified. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Eastern black kingsnake	*Lampropeltis nigra*	III	c	Barren	This species is known to utilize various habitats including dry rocky hills, open woods, dry prairies, stream valleys, and many other habitats	Despite its limited distribution in Virginia, no threats, research, or conservation actions have been identified for this species. This species will be prioritized as Tier 3c.
Reptiles	Eastern box turtle	*Terrapene carolina carolina*	III	a	Forest	This species is known to use a variety of areas including forests, wetlands, and interdunal areas.	This species benefits from the maintenance of open canopied woodlands and meadows with areas of dense ground cover. These habitat needs are consistent with priorities to conserve forest and open habitats in eastern and western Virginia. This species will be prioritized as Tier 3a.
Reptiles	Eastern chicken turtle	*Deirochelys reticularia reticularia*	I	a	Forest	Extreme habitat specalist - only two sites known.	The chicken turtle is only known to occur at First Landing (formerly Seashore) State Park in the City of Virginia Beach and at the Cat Ponds in Isle of Wight County. After several years of survey efforts, only one older female was found at FLSP. This population should be considered biologically extinct. Survey efforts at the Cat Ponds have resulted in what appears to be a small (<30 adults), but stable and reproducing population. The primary focus of conservation for this species should be the permanent protection of the Cat Ponds. This species will be prioritized as Tier 1a
Reptiles	Eastern glass lizard	*Ophisaurus ventralis*	II	a	Forest	Pine savanna and grassy areas near marshes	The needs of this species are consistent with priorities to conserve and restore wetland habitats; including the establishment of vegetative buffers. This species will be prioritized as Tier 2a.
Reptiles	Eastern hog-nosed snake	*Heterodon platirhinos*	IV	c	#N/A	This species inhabits areas with sandy soils. They have been found in fields, open grassy areas adjacent to woodlands, and various forest types.	No threats, research, or conservation actions have been identified for this species. This species will be prioritized as Tier 4c.
Reptiles	Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	IV	a	Open vegetated	Savanna and other open habitats	This species' needs are consistent with priorities to conserve and restore open habitats in eastern portions of Virginia. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Glossy crayfish snake	*Regina rigida rigida*	III	c	Wetland	Freshwater wetland generalist	Additional information regarding this species' distribution and life history are required before other research or conservation needs can be identified. This species will be prioritized as Tier 3c.
Reptiles	Green Sea Turtle	*Chelonia mydas*	I	b	#N/A	#N/A	Very little is known about which habitats this species utilizes in Virginia or how those habitats could be managed to better benefit this species. Research needs are identified with the Virginia and Maryland Sea Turtle Conservation Plan. This species will be prioritized as Tier 1b. This status will be reconsidered as these research needs are addressed.
Reptiles	Kemp's ridley sea turtle	*Lepidochelys kempii*	I	a	#N/A	#N/A	DGIF staff recommend this species be added to the Action Plan and listed as Tier 1a. On the ground species and habitat management strategies have been articulated within the Virginia and Maryland Sea Turtle Conservation Plan.
Reptiles	Leatherback Sea Turtle	*Dermochelys coriacea*	I	c	#N/A	#N/A	DGIF staff have recommended this species be added to the Action Plan and be included as Tier 1c. Very little is known about this species in Virginia waters. It would be beneficial to better determine status. Implementing the Virginia and Maryland Sea Turtle Conservation Plan would likely benefit this species.
Reptiles	Loggerhead sea turtle	*Caretta caretta*	I	a	Shoreline	Nests on ocean-facing beaches and occurs in the lower Chesapeake Bay and inshore, nearshore and offshore coastal waters.	DGIF staff recommend this species be added to the Action Plan and listed as Tier 1a. On the ground species and habitat management strategies have been articulated within the Virginia and Maryland Sea Turtle Conservation Plan.
Reptiles	Mountain earthsnake	*Virginia valeriae pulchra*	II	c	Forest	Forested portions of NW Highland County	DGIF has indicated a need to document this species' distribution, ecological requirements, and life history. This species will be prioritized as tier 2c.
Reptiles	Mudsnake	*Farancia abacura abacura*	IV	a	Wetland	Wetland generalist as long as aquatic salamanders are present	The needs of this species are consistent with priorities to conserve and restore wetlands. This species will be prioritized as Tier 4a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Northern diamondback terrapin	*Malaclemys terrapin terrapin*	II	a	Shoreline	Barrier beaches, estuarine marshes and waters.	The 2005 Action Plan identifies no research or management opportunities specific to this species. Since 2005, this species has become an increasing source of concern. Populations appear to be impacted by loss of submerged aquatic vegetation and foraging habitat, loss of nesting habitat, and mortalities related to crab pots. Regulations have been put in place to prevent the collection of this species. This species will be prioritized as Tier 2a.
Reptiles	Northern map turtle	*Graptemys geographica*	IV	a	Wetland	Clear flowing water with gravel substrates	The needs of this species and its primary prey (freshwater mollusks) are consistent with priorities to conserve and restore aquatic and riparian habitats an manitain good water quality. This species will be prioritized as Tier 4a.
Reptiles	Northern pinesnake	*Pituophis melanoleucus melanoleucus*	I	a	Open vegetated	Dry open slopes with cover and soils suitable for burrowing	The historic range of the pinesnake in Virginia includes at least 5 vouchered and 11 unvouchered records from 11 counties in the Blue Ridge and western Ridge and Valley regions of Virginia. A century ago, pinesnakes were considered common in several parts of Virginia. Prevalence persisted through the mid-1940s up to the mid-1970s. Fire suppression, habitat loss and fragmentation, and human persecution are most likely the primary causes of this species disappearance in Virginia. Because there have been no sightings in the past 25 years, this species is presumed extirpated from Virginia. A recent investigation demonstarted habitat is available and that a reintroduction is feasible. This species is listed as Tier 1a
Reptiles	Queen snake	*Regina septemvittata*	IV	a	Open vegetated	Crayfish obligate clear streams with rock or sandy bottoms and vegetated shorelines	The needs of this species and its primary prey (crayfish)are consistent with priorities to conserve and restore aquatic and riparian habitats and maintain good water quality. This species will be prioritized as Tier 4a.
Reptiles	Rainbow snake	*Farancia erytrogramma erytrogramma*	IV	a	Forest	Riparian forest - eel obligate	The needs of this species and its primary prey (eels) is consistent with priorities to conserve and restore aquatic and riparian habitats an maintain good water quality. This species will be prioritized as Tier 4a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Scarlet kingsnake	*Lampropeltis elapsoides*	III	c	Forest	Forests, meadows and agricultural areas.	For a long time the status of the scarlet kingsnake (*Lampropeltis elapsoides*) in Virginia has been debated and was based on the highly variable phenotypic patterns of the *Lampropetis triangulum* complex. For many years, it was concluded that populations of *L. triangulum* were intergrades between *L.t. triangulum* and *L.t. elapsoides*. In 2007, however, it was concluded that scarlet kingsnakes were a distinct species in Virginia. Genetic samples were limited to southern Bedford County, but specimens from Albemarle, Appomattox and Mecklenburg counties are also considered valid. Unconfirmed photos from Nelson County need to be substantiated. Until the status and distribution can be better defined, this species should be listed as a Tier 3c.
Reptiles	Scarletsnake	*Cemophora coccinea copei*	IV	a	Forest	Forest generalist but require soils suitable for digging	The needs of this species are consistent with action plan priorities to conserve and restore patches of mature forests in the eastern portions of Virginia. This species will be prioritized as Tier 4a.
Reptiles	Smooth greensnake	*Opheodrys vernalis*	III	a	Barren	Moist meadows or grassy areas at the edges of bogs or small streams	This species benefits from the maintenance of balds and other open habitats. This need is consistent with priorities to maintain and create open habitats, including balds, in western portions of Virginia. This species will be prioritized as Tier 3a.
Reptiles	Southeastern crowned snake	*Tantilla coronata*	IV	c	Forest	Forest generalist but require soils suitable for digging	Basic life history and distribution research are needed for this species. This species will be classified as Tier 4c.
Reptiles	Spiny softshell	*Apalone spinifera spinifera*	IV	a	Aquatic	Clean clear rivers with flowing water and sand substrates	The needs of this species are consistent with action plan priorities to conserve and restore aquatic and riparian habitats and maintain good water quality. This species will be prioritized as Tier 4a.
Reptiles	Spotted turtle	*Clemmys guttata*	III	a	Wetland	Freshwater swamps and marshes	The needs of this species are consistent with priorities to conserve and restore wetland habitats. This species will be prioritized as Tier 3a.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Reptiles	Stripe-necked musk turtle	*Sternotherus minor peltifer*	IV	a	Aquatic	Warm streams with fast flows and rock and cobble substrates	The needs of this species are consistent with action plan priorities to conserve and restore aquatic and riparian habitats and maintain good water quality. This species will be prioritized as Tier 4a.
Reptiles	Timber rattlesnake	*Crotalus horridus (timber)*	IV	a	Barren	Hibernates in fissures in rock ledges or talus slopes. When active, utilizes a diversity of forest and open habitats.	This species can best be protected by protecting hibernacula via regulation, acquisition, or other management opportunity. This species would also benefit from action plan priorities to conserve and restore various forest and open habitats. This species will be prioritized as Tier 4a.
Reptiles	Wood turtle	*Glyptemys insculpta*	I	a	Forest	Clear streams with adjacent riparian forests and fields	Virginia's original wildlife action plan indicated this species would benefit from more rigorous enforcement of collection laws and efforts to conserve/restore riparian and upland habitats used by this species. A variety of research topics are also identified. The habitat conservation efforts are consistent with the new action plan's conservation priorities. This species will be prioritized as Tier 1a.
Reptiles	Yellow-bellied slider	*Trachemys scripta scripta*	IV	b	Aquatic	A variety of freshwater habitats including rivers, ponds, lakes, and roadside ditches	This species is most threatened by the red-eared slider which was introducted to Virginia via the pet trade. These two sub-species can breed which diminishes the genetic integrity of the native yellow-eared slider. Before conservation actions can be defined, additional research is required to more fully describe the extent to which the yellow-bellied slider has interbred with, the red-eared slider, determine if the removal of red-eared sliders could be achieved, and determine how to prevent the future introduction of red-eared sliders into additional watersheds. This species will be prioritized as Tier 4b.
Terr Insects	A cane moth	*Argillophora furcilla*	IV	c	Unknown	Variety of habitats as long as there is substantial cane	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A cane moth	*Franclemontia interrogans*	IV	c	Unknown	Not well known	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	A cave beetle	*Pseudanophthalmus gracilis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	A cave beetle	*Pseudanophthalmus seclusus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	A cave beetle	*Pseudanophthalmus pusio*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	A geometrid moth	*Lophosis labeculata*	IV	c	#N/A	#N/A	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A geometrid moth	*Lytrosis permagnaria*	IV	c	Unknown	Not well known	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A ground beetle	*Cyclotrachelus incisus*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	A ground beetle	*Phloeoxena signata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A ground beetle	*Rhadine caudata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A leaf beetle	*Calligrapha pnirsa*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A mirid bug	*Bothynotus johnstoni*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A noctuid moth	*Hadena ectypa*	IV	c	Forest	Wooded areas or openings in them	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	A noctuid moth	*Meropleon titan*	IV	c	Unknown	No habitat requirement	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A noctuid moth	*Oxycilla mitographa*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A noctuid moth	*Zale curema*	IV	c	Forest	Mountain species associated with pitch pine	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A shield bug	*Galgupha denudata*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A spur-throat grasshopper	*Melanoplus pachycercus*	IV	c	Forest	Woodland/ hardwood	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A tiger beetle	*Cicindela formosa generosa*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A tiger beetle	*Cicindela gratiosa*	IV	c	Dune	Sandy soils with some clay content in sparsely vegetated patches	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A tiger beetle	*Cicindela limbalis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	A turtle bug	*Oncozygia clavicornis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	American Bumble Bee	*Bombus pensylvanicus*	IV	a	Unknown	Variety of open and grassland habitats	This species is impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 4a.
Terr Insects	American burying beetle	*Nicrophorus americanus*	I	c	Open habitat	Grassland, old field shrubland, and hardwood forests	There are no known populations of this species in Virginia but it has a high likelihood of occurring in Virginia. Threat to it elsewhere include: habitat fragmentation and the related loss of edge habitat. No management actions are listed in the Action Plan. The research need listed is to conduct surveys to determine if any populations can be found. This species will be prioritized as Tier 1c.
Terr Insects	An assassin bug	*Ploiaria hirticornis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Appalachian grasshopper	*Appalachia hebardi*	III	c	Unknown	Acidic mountain heathlands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Appalachian grizzled skipper	*Pyrgus wyandot*	I	a	Open habitat	Dry open areas with shale soils, clear cuts, utility rights of way, and other areas with dwarf cinquefoil	The primary threats to this species include habitat succession and gypsy moth control measures. The following management action is included: all shale barren and powerline right of ways in the Ridge and Valley should be exempted from gypsy moth spraying. The following research needs are includes: surveys to identify additional populations, understanding the relationship between distribution and density to disturbance regimes. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Arogos skipper	*Atrytone arogos arogos*	I	c	Open habitat	No details for Virginia	This species is likely extripated from Virginia. Historic threats included habitat degradation and poor management. If the species is found in Virginia, a likely management action would be to restore large tracts of native grasses, that support many small, frequent burns.This species will be prioritized as Tier 1c.
Terr Insects	Ashton Cuckoo Bumble Bee	*Bombus bohemicus*	I	a	Open habitat	Various open and grassland habitats.	Bumble bees are impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 1a.
Terr Insects	Avernus cave beetle	*Pseudanophthalmus avernus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Barrens dagger moth	*Acronicta albarufa*	IV	c	Forest	Dry oak dominated habitats, including black oak or bur oak savanna and overgrown former savanna and pitch pine/scrub oak barrens, and especially ozark oak and oak-hickory woods	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Barrens tiger beetle	*Cicindela patruela*	III	c	Unknown	Sandy/coarse gravel or eroding sandstone throughout the species' range	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Black dash	*Euphyes conspicua*	IV	c	Forest	Shrubby or partially wooded (red maple) wetland or part thereof at least co-dominated by *Carex stricta*	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Black lordithon rove beetle	*Lordithon niger*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Brimley's assassin bug	*Pnirontis brimleyi*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Bronze copper	*Lycaena hyllus*	IV	c	Wetland	Marshes, sedge meadows, moist to wet grassy meadows, ditches, fens, streamside or pondshore wetlands, or roads and right of ways through marshlands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Buchholz's gray moth	*Hypomecis buchholzaria*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Buffalo Mountain mealybug	*Puto kosztarabi*	I	c	Open habitat	South slope of Buffalo Mountain in Floyd county on poverty oatgrass in open glades	This species is endemic to Buffalo Mountain in Floyd County, Virginia and the site where it is found is already under state ownership. No threats or management actions are included in the Action Plan. The primary research need includes researching life history and conducting surveys. This species will be prioritized as Tier 1c.
Terr Insects	Burkes Garden cave beetle	*Pseudanophthalmus hortulanus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Chestnut clearwing moth	*Synanthedon castaneae*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Chestnut leaf-mining moth	*Tischeria perplexa*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Combneck assassin bug	*Ctenotrachelus shermani*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Consort underwing	*Catocala consors sorsconi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Crossroads Cave beetle	*Pseudanophthalmus intersectus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Cumberland Gap cave beetle	*Pseudanophthalmus hirsutus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Dark stoneroot borer moth	*Papaipema duplicata*	IV	c	Forest	Foodplant *Collinsonia* is common in rich hardwood forest	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Deceptive cave beetle	*Pseudanophthalmus deceptivus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Delicate cave beetle	*Pseudanophthalmus delicatus*	III	c	Cave/Karst	Subterranean obligate	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Diana fritillary	*Speyeria diana*	IV	c	Forest	Deciduous or mixed forest with a lot of violetds in the understory in most of the range	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Dismal Swamp green stink bug	*Chlorochroa dismalia*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Doll's Merolonch moth	*Merolonche dolli*	III	c	Forest	Acid oak-heath forest	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Dotted skipper	*Hesperia attalus slossonae*	II	c	Open habitat	Short grass prairies, pine barrens, and woodland meadows	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Dukes' skipper	*Euphyes dukesi*	III	c	Wetland	Adjacent open wetlands for nectar, but the primary habitat is sedge	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
						patches in forested swamps	
Terr Insects	Dusky roadside-skipper	*Amblyscirtes alternata*	III	c	Open habitat	Open grassy pine woods but may range from moist to dry, includes moist flatwoods, savannas, and sandhill ridges	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Early hairstreak	*Erora laeta*	IV	c	Forest	Hardwood forests or hardwood-northern conifer mixed forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Frosted elfin	*Callophrys irus*	IV	c	Open habitat	Natural settings, such as grassy openings or burn scars in barrens and savannas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Georgia satyr	*Neonympha areolata*	IV	c	Wetland	Wet to boggy meadows, savannas, and wet pinelands	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Hebard's noctuid moth	*Erythroecia hebardi*	III	c	Forest	Forests with many foodplants	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Hercules club stink bug	*Elasmostethus atricornis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Hessel's hairstreak	*Callophrys hesseli*	III	c	Wetland/ forest	Bog/ fen, ripairian	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Hoary elfin	*Callophrys polios*	IV	c	Open habitat	Rocky or sandy barrens, bogs, outcrops etc. with abundant bearberry. Also in dry rocky forest with *Epigea repens*	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Holsinger's cave beetle	*Pseudanophthalmus holsingeri*	I	c	Cave/Karst	Caves with clean abundant water flowing through the system.	This species is endemic to Young-Fugate Cave in Lee County, Virginia and that the species is stable. The majority of known habitat occurs either beneath or immediately adjacent to US58 in Lee County. Threats to this species include the following: alteration of surface features that would affect the water table such as removal of forest cover, road construction, and water pollution in various forms. Management actions include limiting gyspy moth spraying near caves where this species is found. Research needs include life history studies and regular surveys to determine current status of the species.This species will be prioritized as Tier 1c.
Terr Insects	Hubbard's cave beetle	*Pseudanophthalmus hubbardi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Hubricht's cave beetle	*Pseudanophthalmus hubrichti*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Jefferson's short-nosed scorpionfly	*Brachypanorpa jeffersoni*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	King's hairstreak	*Satyrium kingi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Lemmer's pinion moth	*Lithophane lemmeri*	IV	c	Wetland	Swamps with Atlantic white cedar (Chamaecyparis thyoides) dominant or at least common	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Little Kennedy Cave beetle	*Pseudanophthalmus cordicollis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Little metalmark	*Calephelis virginiensis*	III	c	Open habitat	Open grassy fields, pine savanna, salt marsh meadows, and wood margins	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Long dash	*Polites mystic*	IV	c	Open habitat	Lush, moist flowery meadows whether natural or artificial, including old fields, pastures, hayfields	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Long-headed cave beetle	*Pseudanophthalmus longiceps*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Maiden Spring cave beetle	*Pseudanophthalmus virginicus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Marbled underwing	*Catocala marmorata*	IV	c	Forest	Riparian and forest	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Milne's Euchlaena moth	*Euchlaena milnei*	IV	c	Forest	Unknown, but appears to be in hardwood forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Mississippi turtle bug	*Allopodops mississippiensis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Mitchell's satyr	*Neonympha mitchellii*	I	a	Wetland	Calcareous fen complexes, sedge meadows	The primary threats facing this species include: loss of wetland habitat (sedge fens or meadows) and historic over collection. This species would likely benefit from the conservation and restoration of wetland habitats. This species will be prioritized as Tier 1a.
Terr Insects	Mixed dart moth	*Euxoa immixta*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Monarch Butterfly	*Danaus plexippus plexippus*	III	a	Open habitat	Breeding areas are virtually all patches of milkweed in North America and some other regions	Threats to this species includes the loss of milkweed and nectar sources in agricultural lands and the loss of forests in the US, Canada, and Mexico. Actions to conserve monarchs include the conservation and restoration of existing grasslands with milkweed and other nectar producing plants, and working to conserve known migratory roost sites. Habitat guidelines from DGIF's Quail Action Plan should be consistent with habitats needed by monarchs. This species will be prioritized as Tier 3a.
Terr Insects	Mottled duskywing	*Erynnis martialis*	III	c	Forest	Strongly associated with various sorts of oak (black, post, etc.) or pine (jack, pitch, longleaf) savannas or open woodlands, non-coastal pine barrens, or grassy openings within these communities, also probably embankments along rivers	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Mud-dwelling cave beetle	*Pseudanophthalmus limicola*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Natural Bridge cave beetle	*Pseudanophthalmus pontis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Nelson's cave beetle	*Pseudanophthalmus nelsoni*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	New River Valley cave beetle	*Pseudanophthalmus egberti*	II	c	Cave/Karst	Twilight zone or deeper in or on moist soil, often near streams or drip areas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*	II	a	Beach	Beach obligate - does not tolerate heavy foot or vehicle traffic	Management largely focused on conserving beach habitats and excluding human use from occupied areas. This species will be prioritized as Tier 2a.
Terr Insects	Northern bush katydid	*Scudderia septentrionalis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Northern metalmark	*Calephelis borealis*	IV	c	Forest	Openings within forested or wooded areas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Orange-bellied tiger beetle	*Cicindela abdominalis*	IV	c	Dune/ open habitat	Dry, sandy, coastal plain pine barrens, sand hills, and other pine or mixed pine-oak woodland or scrub	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Overlooked cave beetle	*Pseudanophthalmus praetermissus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Palatka skipper	*Euphyes pilatka*	III	c	Wetland	Brackish and freshwater sawgrass marshes and mangroves	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Persius duskywing	*Erynnis persius persius*	II	c	Open habitat	Pine barrens/ oak savanna and other open sunny habitats	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Petrunkevitch 's cave beetle	*Pseudanophthalmus petrunkevitchi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Pine barrens underwing	*Catocala herodias*	III	c	Open habitat	Scrubby oaks, pine barrens, and some oak savanna	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Pink-edged sulphur	*Colias interior*	IV	c	Open habitat	Bogs, any kind of low heathland, pine barrens, burn scars, logged areas, right of ways, other openings in forests	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Pink-streak moth	*Faronta rubripennis*	IV	c	Open habitat	Natural sandy grassy situations such as prairies and dunes	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Precious underwing	*Catocala pretiosa pretiosa*	II	c	Forest	Pinelands swamp forest	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Rare skipper	*Problema bulenta*	II	c	Wetland	Freshwater and brackish marsh	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Rare spring moth	*Heliomata infulata*	IV	c	Forest	Forest or woodland specie	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Regal fritillary	*Speyeria idalia idalia*	I	a	Open habitat	Glades and priairie remnants	The likely threats to this species include spraying for gyspy moth and increasing distance between suitable habitats. Management actions include the following: protection of remaining grasslands within its range, cessation of collection, and suspension of spraying for gypsy moth where it likely occurs. This species will be prioritized as Tier 1a.
Terr Insects	Riverbank tiger beetle	*Cicindela ancocisconensis*	III	c	Riparian	Open sand or a matrix of sand and cobble along permanent streams or medium-sized rivers	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Rotund cave beetle	*Pseudanophthalmus rotundatus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Rusty-patched bumble bee	*Bombus affinis*	I	a	Open habitat	Various open and grassland habitats.	Bumble bees are impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 1a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Saint Paul cave beetle	*Pseudanophthalmus sanctipauli*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Sandpit alydid bug	*Stachyocnemus apicalis*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Schaum's ground beetle	*Sphaeroderus schaumi*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Silken cave beetle	*Pseudanophthalmus sericus*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Six-banded longhorn beetle	*Dryobius sexnotatus*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Smyth's Apamea moth	*Apamea smythi*	II	c	Forest	Forested areas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	South Branch Valley cave beetle	*Pseudanophthalmus potomaca potomaca*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Southeastern myotis bat fly	*Basilia boardmani*	III	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Southern Plains Bumble Bee	*Bombus fraternus*	II	a	Open habitat	Various open and grassland habitats.	Bumble bees are impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 2a.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Southern Ptichodis moth	*Ptichodis bistrigata*	IV	c	Forest	Probably xeric, maybe also mesic, pine/oak scrub, savanna and prairie	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Spectral tiger beetle	*Cicindela lepida*	IV	c	Dune	Open, deep, dry, sparsely vegetated sands, as weel as dunes, openings in various woodlands, old sand pits, sandy washes in some areas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Spotted cave beetle	*Pseudanophthal mus punctatus*	II	c	Cave/Karst	#N/A	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Straley's Cave beetle	*Pseudanophthal mus quadratus*	II	c	Cave/Karst	Twilight zone or deeper in or on moist soil, often near streams or drip areas	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Sweet underwing	*Catocala dulciola*	III	c	Forest	Forest species	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 3c.
Terr Insects	Tawny crescent	*Phyciodes batesii batesii*	II	c	Open habitat	Dry habitats, including clearings, open woods and roadsides containing wavy-leaved asters	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Thin-neck cave beetle	*Pseudanophthal mus parvicollis*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Thomas' cave beetle	*Pseudanophthal mus thomasi*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Tuscarora emerald	*Nemoria tuscarora*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

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Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Two-spotted skipper	*Euphyes bimacula*	IV	c	Wetland	Bogs, sedge meadows, sedge marshes along streams and sometimes openings in swamps	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Variable Cuckoo Bumble Bee	*Bombus variabilis*	I	a	Open habitat	Various open and grassland habitats.	Bumble bees are impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 1a.
Terr Insects	Vicariant cave beetle	*Pseudanophthalmus vicarius*	II	c	Cave/Karst	Caves with clean abundant water flowing through the system.	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 2c.
Terr Insects	Yellow Bumble Bee	*Bombus fervidus*	IV	a	Unknown	Variety of open and grassland habitats	This species is impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 4a.
Terr Insects	Yellow stoneroot borer moth	*Papaipema astuta*	IV	c	Forest	Wooded environment with *Collinsonia*	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.

APPENDIX A. VIRGINIA SPECIES OF GREATEST CONSERVATION NEED

Taxa	Common Name	Scientific Name	Tier	Cons. Opp. Ranking	Habitat	Descriptive Habitat	Notes
Terr Insects	Yellow-banded Bumble Bee	*Bombus terricola*	III	a	Unknown	Various open and grassland habitats.	Bumble bees are impacted by habitat loss, insecticide use, climate change, pathogens from captive bees, exotic and invasive species, and intentional and accidental deaths. Actions to conserve bumble bees include managing pesticide free grassland and young forest habitats with suitable forage plants and nest sites. Habitat guidelines from the Wildlife Management Institute's Young Forest Project and the DGIF's Quail Action Plan should be suitable to enhance bumble bee conservation. This species will be prioritized as Tier 3a.
Terr Insects	Yellow-edged Pygarctia moth	*Pygarctia abdominalis*	IV	c	Unknown	Unknown	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.
Terr Insects	Yucca giant-skipper	*Megathymus yuccae*	IV	c	Dune	Coastal dunes, dry pine woods, sandy fields	No specific research needs or management actions have been identified for this species. This species will be prioritized as Tier 4c.