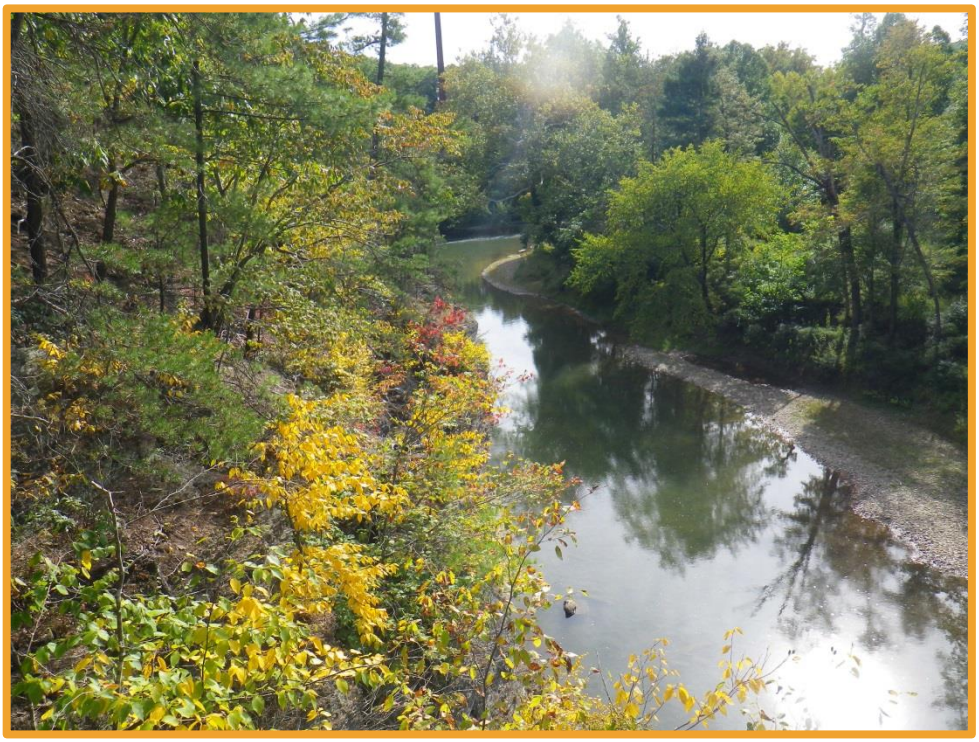
Action Plan for the Cacapon River & Patterson Creek Conservation Focus Area



West Virginia Division of Natural Resources

January 2021

Table of Contents

List of Tables

List of Maps

List of Acronyms Used

ACEP- Agricultural Conservation Easement Program
BMPs- Best Management Practices
B-Rank- Biodiversity Rank
CFA- Conservation Focus Area
CERW- Cerulean Winged Warbler
CCV- Cave Conservancy of the Virginias
CCVI- Climate Change Vulnerability Index
CREP- Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CSP- Conservation Stewardship Program
EQIP- Environmental Quality Improvement Program
FSA- Farm Service Agency
GWWA- Golden-winged Warbler
G Rank- Global Rank
GWNF- George Washington National Forest
HUC- Hydrologic Unit Code
MNF- Monongahela National Forest
NRCS- Natural Resources Conservation Service
NWTF- National Wild Turkey Foundation
R8- Region 8
RFSS- Regional Forester's Sensitive Species
RGS- Roughed Grouse Society
SGCN- Species of Greatest Conservation Need
S Rank- State Rank
SWAP- State Wildlife Action Plan
TNC- The Nature Conservancy
TU- Trout Unlimited
USDA- United States Department of Agriculture
USFWS- United States Fish and Wildlife Service
WMA- Wildlife Management Area
WVACS- West Virginia Association for Cave Studies
WVCA- West Virginia Conservation Agency
WVCC- West Virginia Cave Conservancy
WVDEP- West Virginia Department of Environmental Protection
WVDHHR- Department of Health and Human Resources
WVDNR- West Virginia Division of Natural Resources
WVDOF- West Virginia Division of Forestry
WVDOH- West Virginia Division of Highways
WVU- West Virginia University

Executive Summary

In 2015 the West Virginia Division of Natural Resources (WVDNR) completed the State Wildlife Action Plan (SWAP) with the input of numerous stakeholders from across the state, including public agencies and land managers, researchers, local and regional conservation organizations, volunteer groups, private landowners and members of the public. The 2015 SWAP identified 21 Conservation Focus Areas (CFAs), each with a distinctive set of Species of Greatest Conservation Need (SGCN), wildlife habitats, stresses that can adversely affect those species, and conservation opportunities to address those stresses. In 2018 the WVDNR and The Nature Conservancy (TNC) began convening a working group of local stakeholders including public agencies and land managers, watershed groups, cave interest groups and other non-profit conservation organizations working in the area to develop this Action Plan for the North Fork Mountain-Thorn Creek CFA. This Action Plan addresses the eight essential elements required in the SWAP. It provides an overview of the landscape and major habitat types within this CFA, including forest and woodland habitats, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. It also identifies 240 plant and animal SGCN that are priorities for conservation within this CFA based on factors such as their abundance, distribution, population trends and opportunities for conservation. For each major habitat type the Action Plan lists the priority species, stresses, and voluntary actions that can be taken by private landowners, public land managers and partner organizations for the conservation of wildlife species and their habitats. Climate stresses impacting each major habitat type and potential actions to boost their resilience are also listed. A plan for implementation for each major habitat type lists partners and programs available to assist with each of the actions and metrics for monitoring conservation success. There is also a summary of other human benefits that may be generated by the proposed conservation actions in each major habitat type. The Action Plan also describes a regional network of resilient and connected landscapes within which wildlife species can adapt and shift to a changing climate, identifies high integrity as well as resilient and connected landscapes within the CFA, and provides an implementation plan for landscape resilience and connectivity. The plan concludes with a summary of the priority habitats for conservation, describes the importance of combining conservation actions for greater impact and connecting them across the landscape for climate resilience, and outlines next steps in plan implementation.

Local stakeholders can use this plan to identify priority species, the habitats and stresses within the CFA, as well as partners who can assist with planning, implementation and monitoring of conservation actions to conserve wildlife and enable climate adaptation. The information in this plan can also be used to inform conservation projects being planned by partners and provide justification for grant applications and other proposals seeking to conserve priority species and habitats. Local stakeholders can also work with relevant agencies to develop strategies to avoid, minimize and mitigate impacts to priority species, their habitats, and the resilient and connected landscapes within this CFA.

Conserving wildlife species and their habitat within this CFA will rely upon the voluntary actions of local landowners, public agencies and partner organizations, with support from the WVDNR. WVDNR will convene a working group of local stakeholders on a regular basis to provide guidance, assistance and support the plan, implement, and monitor conservation actions, facilitate stakeholder collaboration, and update the Action Plan every 10 years or sooner if needed.

Introduction to the State Wildlife Action Plan & Conservation Focus Areas

The West Virginia Division of Natural Resources (WVDNR) manages the state's wildlife resources as part of the public trust. A goal of the WVDNR is to support and promote a sense of ownership in the conservation community and the public for the unique habitats and wildlife resources in West Virginia. The 2015 West Virginia State Wildlife Action Plan (SWAP) was therefore developed to also function as a blueprint for conservation that other natural resource agencies, local governments, non-governmental organizations, and the general public can use and apply (WVDNR 2015). The SWAP is intended to have a ten-year timeframe and to be updated by 2025.

Species of Greatest Conservation Need, Habitats and Stresses

The 2015 SWAP identified 681 wildlife Species of Greatest Conservation Need (SGCN) across the state. Because plants are a fundamental element of habitat for wildlife SGCN, a list of SGCN plants was also developed, including 482 plant species.

The SWAP classified and mapped nineteen terrestrial habitats across the state. These include 16 natural or semi-natural habitats that are derived from NatureServe's Ecological Systems (Comer et al. 2003, Gawler 2008) and three anthropogenic habitats that represent map classes of the National Land Cover Database (Homer et al. 2004). In addition, the SWAP classified and mapped eighteen aquatic habitat types. These are GIS-derived types based on a simplification for West Virginia of the Northeast Aquatic Habitat Classification System (Anderson et al. 2013). Stream size is considered the most influential effect on determining biological assemblages at the reach scale and is divided into four primary classes: headwaters and creeks, small rivers, medium rivers, and large rivers. Stream slope, or gradient, affects aquatic communities at the reach scale due to its influence on stream bed morphology, water velocity, and sediment dynamics. Three relative classes (low, moderate, high) of gradient are used to define West Virginia's streams. Water temperature in streams is a key physiological characteristic determining where different stream organisms may persist. Temperature affects seasonal migrations, growth rates, body condition, and fecundity of biota. Three temperature classes (cold, cool, warm) based on continuously recorded data and modeled environmental variables were used to determine biological constraints on stream communities in this model. The characteristics, distribution, trends, and threats associated with each of the terrestrial and aquatic habitats are described in the 2015 SWAP. This Conservation Focus Area Action Plan uses those same habitat classifications.

For those SGCN listed in the SWAP and their associated habitats, WVDNR staff developed a statewide stress assessment using the classification system of the International Union for Conservation of Nature. Terrestrial stresses were addressed at the habitat level within ecoregions. Aquatic stresses were addressed at the HUC 8 watershed level within ecoregions. The resulting analysis identified 21 major statewide stresses affecting terrestrial SGCN and habitats and 20 major stresses that affect aquatic SGCN and habitats. Stresses exerted on SGCN populations and habitats can reduce species populations either directly, by disease, or indirectly, by affecting the quality or quantity of available habitat.

Conservation Actions

The purpose of stress assessment and prioritization in the 2015 SWAP was to identify statewide conservation actions that could reduce stress on SGCN populations and their habitats. Most stresses are the result of the lawful activities of people, corporations, and public agencies. Rather than seeking a

regulatory approach to restrict lawful activities, the intention of the SWAP was to promote voluntary collaboration with landowners, corporations, and other partner organizations and agencies to reduce stresses on wildlife species and their habitats.

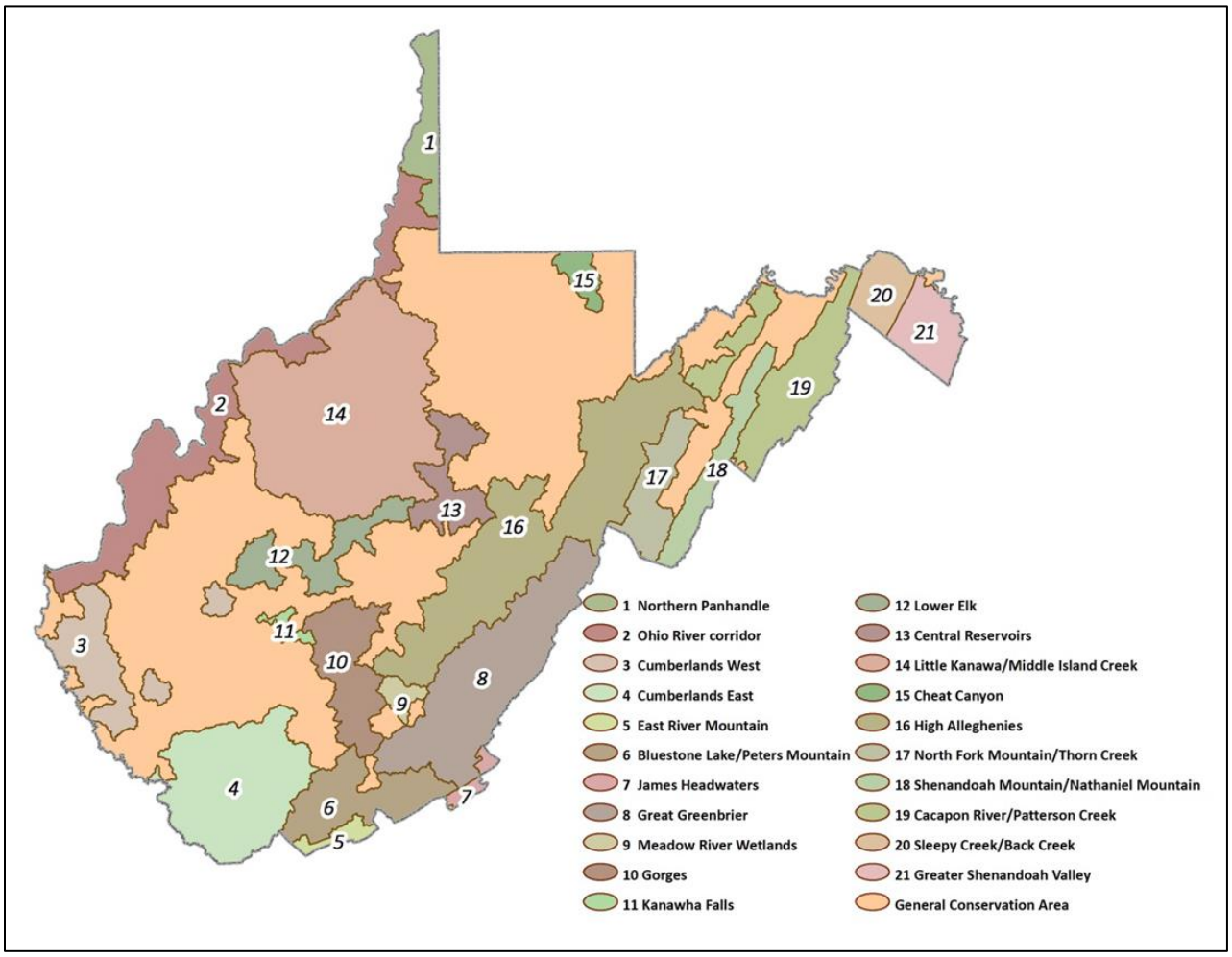
Conservation actions vary according to the species and the specific stresses being addressed and can take many forms. A lack of information on the status of a species or understanding of a threat may indicate a need for actions such as baseline inventory, research, or data acquisition. Direct action may involve directly protecting or restoring habitats. Conservation easements are a form of habitat protection that preserves habitat in its current state or can include land management plans that benefit wildlife. It is likely that a suite of actions is required, depending on the identified stress and the conservation opportunities available. Ideally, actions are designed to address the source of the stress (AFWA 2011). Conservation actions must also address habitat integrity and ecosystem processes. This includes conserving or preserving intact and functional habitats, protecting, or restoring aquatic resources, and maintaining and restoring connectivity between habitats (AFWA 2012, Byers and Norris, 2011).

Conservation Focus Areas and Action Plans

The SWAP provides a broad framework for conservation across West Virginia. However, wildlife species are concentrated in different parts of the state, and exposed to multiple, and often similar, stresses at state, regional, and local scales. Conservation Focus Areas (CFAs) are specific regions in the state where SGCNs are concentrated, addressable threats are identified, and where feasible opportunities exist for focused actions that will achieve success. In completing the 2015 SWAP, WVDNR defined 21 CFAs across the state based on these factors. The map on the following page illustrates the CFAs in West Virginia.

In addition to conservation actions at the statewide level, the 2015 SWAP envisioned that planning at the CFA level would be necessary to fully implement successful conservation, and to further define conservation actions and measurable outcomes for most SWAP-based activities. The SWAP also noted that investing conservation resources in the CFAs could increase the potential for collaboration with partners and landowners, as well as the efficiency and effectiveness of conservation on the ground. CFA Action Plans have been developed to identify priority SGCN from each taxa group in each major habitat type, key stresses and actions that will effectively secure or protect priority species and their habitats within the CFA. The Action Plans also identify public lands that can provide opportunities for conservation in collaboration with public land managers. And because many SGCN and their habitats occur on private property within CFAs, conservation actions will require collaboration with private landowners, as well as partner organizations and stakeholder groups. Many local partners have relations with landowners as well as the expertise, capacity, resources, and funding to plan and implement the actions listed in CFA Action Plans. CFA planning engages local partners and stakeholders at a scale where collaboration can increase resources (funding, capacity) available for conservation action. WVDNR has engaged a working group of local partners in developing each CFA Action Plan and intends to facilitate, guide and support partner efforts in planning, implementation, and evaluation of conservation actions to implement the plans.

Conservation Focus Areas in West Virginia.



Climate Change and Resilience

The 2015 SWAP listed climate change as a substantial threat to wildlife and plant populations, noting several recent studies. For example, an assessment of the relative vulnerability to climate change of 185 animal and plant species in West Virginia (Byers and Norris, 2011) identified natural and anthropogenic barriers to movement and dispersal, and physiological thermal and hydrological niches occupied by some species as risk factors correlated with vulnerability to climate change. Over half of the species assessed were determined to be vulnerable to climate change. This study and the SWAP identified climate change as a stressor particularly for cool and coldwater fish, mollusks, plants, terrestrial salamanders, and many species associated with wetlands and high elevation ecosystems. The SWAP listed habitat shifts and alterations as statewide stresses for terrestrial SGCN and it listed increasing frequency and severity of drought, storms and flooding and temperature extremes as statewide stresses for aquatic SGCN and habitats. The SWAP observed that even within taxonomic and habitat groupings, species may respond differently to climate change based on their sensitivity to factors such as temperature, moisture, and seasonal triggers. Furthermore, climate change acts in tandem with other stresses on wildlife and habitat, and actions to address those other stresses could decrease their vulnerability to climate change. And actions to address climate impacts would vary between CFAs, emphasizing restoration and expansion of vulnerable habitat types in some areas, or reducing habitat fragmentation in others. The SWAP further

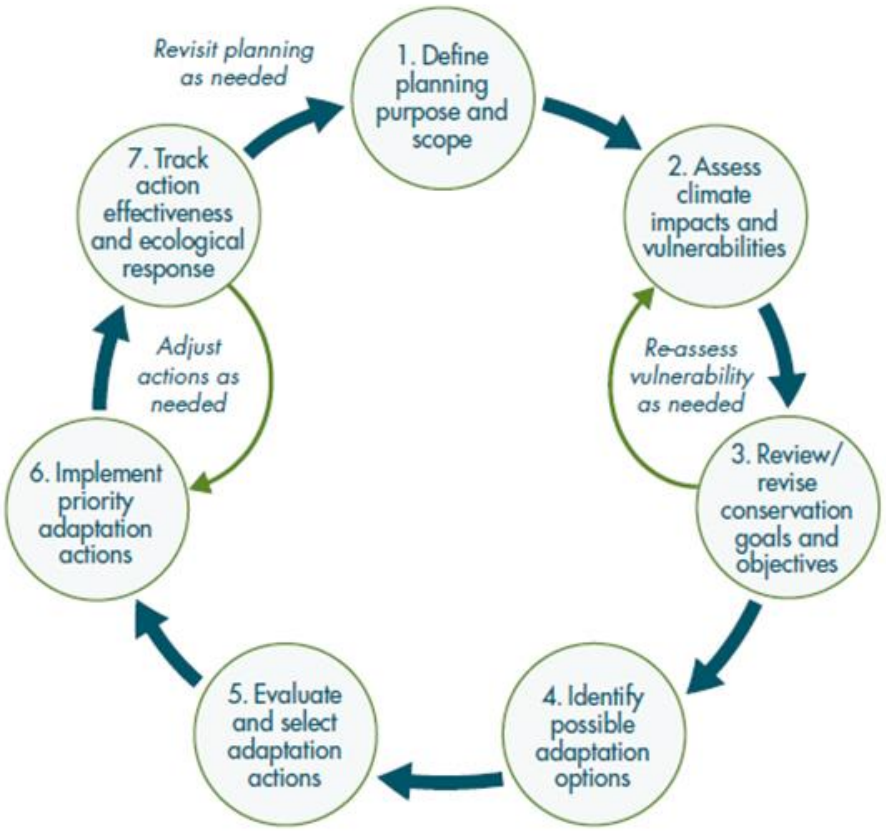
stated that efficient approaches to maintaining broad suites of species include maintaining functioning ecological systems, landscapes that are resilient to the effects of climate change, and ecological connectivity within and between landscapes. Rather than a species-specific approach, the SWAP therefore sought to address climate change broadly through additional vulnerability assessments for select species, statewide actions to reduce additional stresses on SGCN and their habitats, and more geographically focused actions in Conservation Focus Areas (CFAs). CFAs are an appropriate scale to promote climate resilience by identifying local actions to relieve stresses on SGCN, restore or expand vulnerably habitats, and maintain ecosystems process, landscape resilience and connectivity.

Monitoring and Adaptive Management

Monitoring of SGCN and their habitat is essential to establish better baseline data about species distribution, abundance, and population trends. The SWAP envisioned monitoring of species and habitat trends across the state, along with more intensive monitoring within CFAs through collaboration with local partners to gain more area-specific data and to address local threats with targeted conservation actions.

Beyond monitoring SGCN and their habitat, successful wildlife conservation in CFAs will require monitoring the effectiveness of conservation actions and adapting those actions accordingly. The SWAP envisioned monitoring the results of conservation actions at the CFA level, and that CFA-level plans would incorporate measurement and monitoring protocols integrated with conservation actions themselves. Effectiveness measures indicate progress to date and whether the expected results are being realized. Conservation actions should be designed with enough specificity that project impacts and performance can be measured but broadly enough to benefit multiple species and engage partners. Success may be measured by the amount of protected or restored habitat, by stable or increasing populations, or by acquiring a more complete understanding of species and threats in order to make informed conservation decisions. Another measure of success is the amount of "buy-in" or participation by conservation partners in the public and private sectors. Conservation partners, especially those operating through grant funding or those following conservation agency protocols, may already have metrics for accomplishment/success that are used for their own reporting requirements. Furthermore, accountability and transparency to funding sources, partners, and the public are essential for program success.

Adaptive management also requires monitoring of climate change impacts on species, their habitats, and the success of conservation actions. Conservation actions are intended to reduce stresses on SGCN and their habitats, and to enable species to adapt to changing conditions. In common terms, climate adaptation may be thought of as preparing for, coping with, or adjusting to climatic changes and their associated impacts (Stein et al. 2014). Planning conservation actions for climate adaptation will require consideration of climate impacts, vulnerabilities and adaptation options, and careful monitoring of project effectiveness and ecological response. Frameworks such as the Climate Smart Conservation Cycle illustrated below (from Stein et. al, 2014) can be used to plan, implement, and monitor conservation actions to enable wildlife to adapt to a changing climate. Planning and monitoring conservation actions may be informed by the climate impacts to species and habitats, WVDNR's ongoing vulnerability assessments and field surveys to further document the distribution, abundance, and population trends of priority species, and the options to build the resilience of each major habitat type listed in this Action Plan. Information on site conditions and project plans provided by partners and landowners should also be considered. This will require careful coordination among WVDNR and local stakeholders.



Climate-Smart Conservation Cycle
A General Framework for Adaptation Planning and Implementation

Organization of this Action Plan

This CFA Action Plan will begin by introducing the CFA, including an overview of the landscape, terrestrial and aquatic habitats, species of greatest conservation need, distinctive stresses and broad conservation actions, potential partners and lands protected by public ownership or conservation easements. The Action Plan then reviews the conservation goals and lists priority species identified by WVDNR specialists based on factors such as their abundance, population trends and opportunities for conservation within the CFA. The Action Plan is then divided by major habitat type, including forest and woodland habitats, rock outcrop, cliffs and talus and shale barren habitats, aquatic, floodplain and riparian habitats, karst and cave habitats, and developed and agricultural habitats. For each major habitat type the Action Plan lists priority species, stresses effecting those species, and actions to alleviate those stresses. The Action Plan also identifies climate stresses impacting each major habitat type and lists potential actions to boost their resilience. The Action Plan provides a plan for implementation and monitoring of conservation actions for each major habitat type, and a brief statement about other human benefits that may be generated by the proposed actions. The Action Plan also describes a regional network of resilient and connected landscapes spanning multiple habitat types to enable wildlife species to adapt and shift to a changing climate and provides an implementation plan for landscape resilience and connectivity. The conclusion provides a summary of the priority habitats for conservation, describes the importance of integrating conservation actions for greater impact and connecting conservation actions for climate resilience, and outlines next steps in plan implementation.

How to use this plan

Implementation of this plan will rely upon voluntary actions by local stakeholders including landowners, public agencies and partner organizations, and collaboration between them to conserve wildlife species and their habitat. The role of WVDNR in implementing this Action Plan is to provide local stakeholders with information, guidance, assistance, and support to plan, implement, and monitor conservation actions, and facilitate stakeholder collaboration.

Local stakeholders can use this plan for many purposes, including the following:

- Identify priority wildlife species, rare plant communities and their habitats, and the resilient and connected landscapes that can enable species to shift in response to changing conditions.
- Work with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to priority species, their habitats, and the resilient and connected landscapes.
- Identify stresses on priority species in specific habitats, conservation actions that can alleviate those stresses, monitoring protocols to evaluate success, and partners who can provide assistance.
- Understand climate impacts on wildlife habitat, and actions to boost habitat resilience.
- Plan and implement conservation actions to alleviate stresses on wildlife species in specific habitat, boost habitat resilience, and enable wildlife to adapt to climate change.
- Design and implement monitoring protocol to evaluate the success of conservation actions.
- Inform and provide rationale for activities being proposed in grant or permit applications.
- Integrate priority species, habitat, and climate resilience into other local project plans.

The information provided in this Action Plan is constantly evolving. Local stakeholders are encouraged to seek additional information and assistance from WVDNR to:

- Confirm whether specific priority wildlife species and habitats are present at specific sites
- Understand their vulnerability to climate change
- Further define or confirm stresses on wildlife species and habitats
- Tailor proposed wildlife conservation actions to alleviate stresses
- Consider adaptation options to boost habitat resilience to climate change
- Develop effective strategies to monitor and evaluate project success

The Cacapon River and Patterson Creek Conservation Focus Area

Overview

The Ridge and Valley Ecoregion includes the entire watersheds of the Cacapon River and Patterson Creek. The Cacapon watershed includes two large tributary drainages, the North River and Lost River. Both watersheds are in the Potomac Basin and have many ecological and land-use similarities. A map of the CFA is on the following page.

The valleys in both the Cacapon and Patterson Creek watersheds are below 1000 feet in elevation & have narrow, but well-developed floodplains along the larger streams. The shale uplands give way to parallel ridges of mostly shale and sandstone. Areas of limestone occur in both watersheds. Higher mountains, some rising above 3000 feet, include:

`

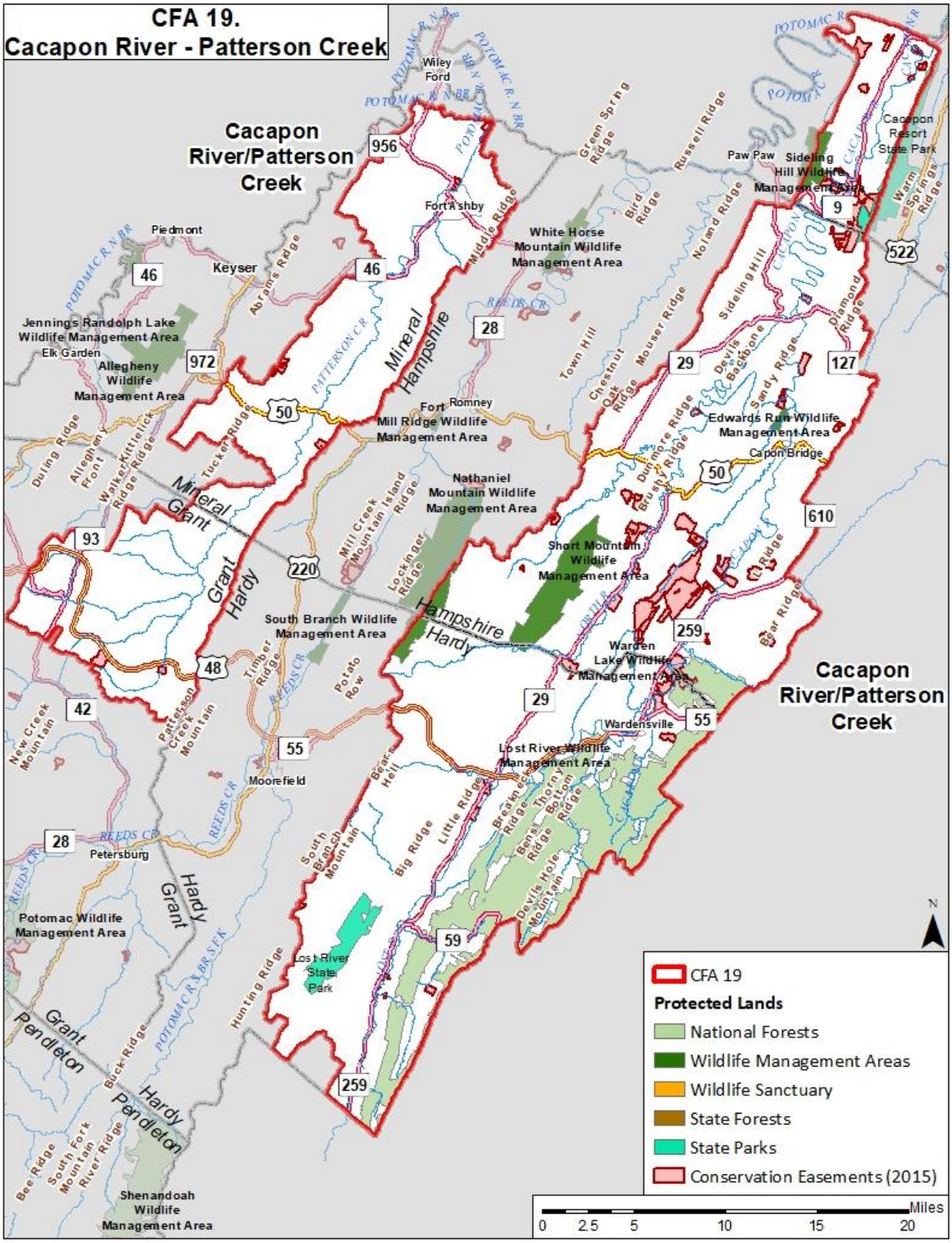
- Cacapon Mountain
- Great North Mountain
- Short Mountain
- Long Mountain
- Patterson Creek Mountain
- Knobly Mountain
- Allegheny Mountain (the Allegheny Front)

The ridgetops and upper slopes in this CFA are mostly forested, with several medium and large intact forest areas or "blocks" remaining primarily in the Cacapon Watershed. Privately owned forestland is mostly in small to medium sized tracts and used for forestry and recreation. Some of the lower ridges support apple orchards, while lower uplands & river bottoms are mostly used for agriculture. Agriculture practices are primarily livestock production and include pasture and hay lands and corn production. Poultry operations also occur in both watersheds. Residential development is prevalent in the Cacapon Watershed, especially along the Cacapon River downstream of North River and adjacent to public land. Small towns in the Cacapon watershed include Wardensville and Capon Bridge.

There is substantial public land in the eastern portion of the Cacapon Watershed, including the George Washington National Forest, Cacapon State Park, Sideling Hill Wildlife Management Area, and Short Mountain Wildlife Management Area. Lost River State Park lies in the southwest portion of the watershed.

Communities and towns present in the Patterson Creek watershed include Williamsport, Burlington, and Fort Ashby. There are no state or federal lands in the Patterson Creek watershed.

Overview


CFA 19.
Cacapon River - Patterson Creek
Cacapon River/Patterson Creek
Wiley Ford
Fort Ashby
Piedmont
Keyser
White Horse Mountain Wildlife Management Area
Jennings Randolph Lake Wildlife Management Area
Elk Garden
Allegheny Wildlife Management Area
Fort Romney
Mill Ridge Wildlife Management Area
Nathaniel Mountain Wildlife Management Area
Short Mountain Wildlife Management Area
South Branch Wildlife Management Area
Warden Lake Wildlife Management Area
Lost River Wildlife Management Area
Wardensville
Moorefield
Petersburg
Potomac Wildlife Management Area
Lost River State Park
Shenandoah Wildlife Management Area
Edwards Run Wildlife Management Area
Capon Bridge
Paw Paw Sideling Hill Wildlife Management Area
Cacapon Resort State Park
Mineral
Hampshire
Grant
Hardy
Pendleton
CFA 19
Protected Lands
National Forests
Wildlife Management Areas
Wildlife Sanctuary
State Forests
State Parks
Conservation Easements (2015)
Miles
0 2.5 5 10 15 20

Habitats

The Cacapon River and Patterson Creek CFA includes a variety of terrestrial, subterranean, and aquatic habitat types.

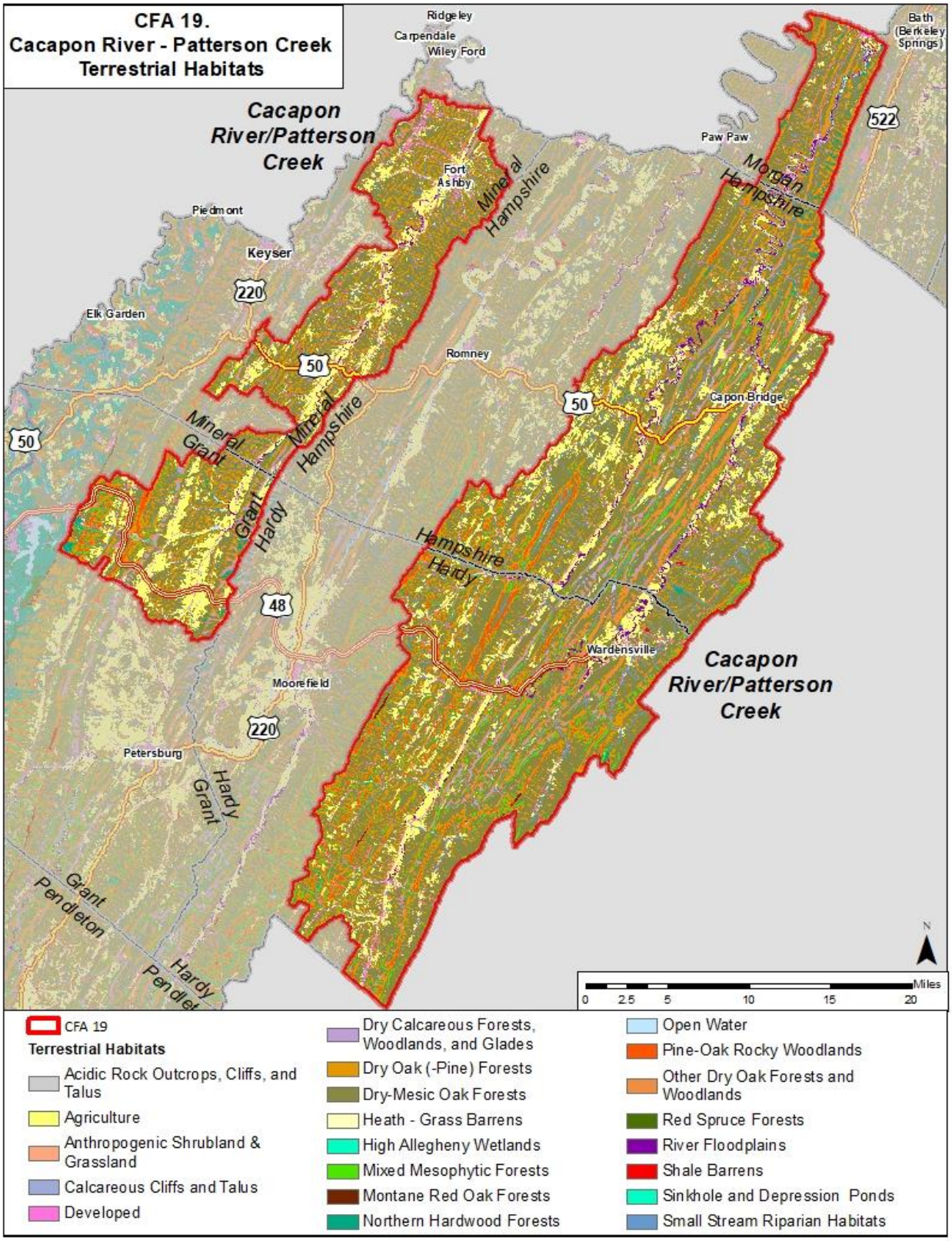
Terrestrial Habitats

This Action Plan uses the terrestrial habitat types described in the SWAP, fourteen of which are present in this CFA. This CFA includes over 15% of the state's dry calcareous forests and its pine oak rocky woodlands. Shale barrens represent a tiny portion of the terrestrial habitats in this CFA yet represent over 22% of the state's total shale barren habitat.

Terrestrial Habitat Summary

HABITAT TYPE	ACRES IN CFA	PERCENT OF CFA AREA	PERCENT OF WV TOTAL FOR HABITAT TYPE
Acidic Rock Outcrops, Cliffs, and Talus	442	0.07%	0.49%
Agriculture	79,674	13.17%	5.55%
Calcareous Cliffs and Talus	494	0.08%	5.37%
Developed	24,267	4.01%	2.13%
Dry Calcareous Forests, Woodlands, and Glades	11,225	1.86%	15.69%
Dry Oak (-Pine) Forests	111,198	18.39%	4.50%
Dry-Mesic Oak Forests	293,876	48.59%	5.89%
Mixed Mesophytic Forests	14,076	2.33%	0.48%
Montane Red Oak Forests	1,103	0.18%	5.22%
Northern Hardwood Forests	3,769	0.62%	0.38%
Other Dry Oak Forests and Woodlands	21,147	3.50%	18.12%
Pine-Oak Rocky Woodlands	11,782	1.95%	15.42%
Red Spruce Forests	11	0.00%	0.01%
River Floodplains	7,213	1.19%	6.00%
Shale Barrens	408	0.07%	22.75%
Small Stream Riparian Habitats	24,126	3.99%	4.88%
Totals	604,812	100.00%	

Terrestrial Habitats



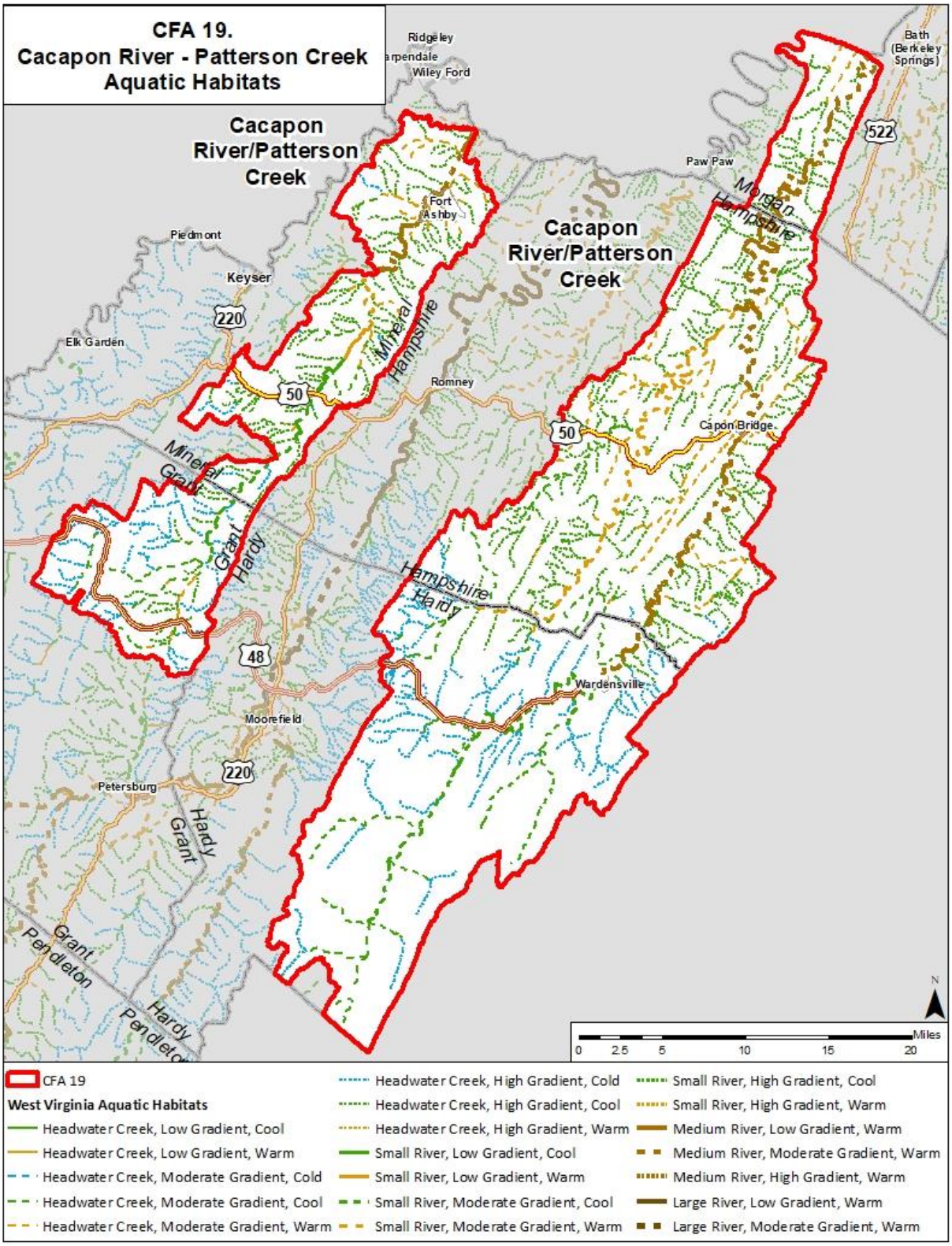
Aquatic Habitats

Twelve of the aquatic habitat types described in the SWAP are present within the Cacapon River and Patterson Creek CFA, including over 15% of the state's cool, low gradient small river habitat and its warm, moderate gradient medium river habitat.

Aquatic Habitat Summary

HABITAT TYPE	MILES IN CFA	PERCENT OF CFA MILES	PERCENT OF WV TOTAL FOR HABITAT TYPE
Headwater Creek, Low Gradient, Cool	1	0.07%	6.18%
Headwater Creek, Low Gradient, Warm	7	0.59%	1.31%
Headwater Creek, Moderate Gradient, Cool	173	13.99%	7.89%
Headwater Creek, Moderate Gradient, Warm	119	9.64%	3.05%
Headwater Creek, High Gradient, Cold	249	20.13%	8.49%
Headwater Creek, High Gradient, Cool	494	39.90%	7.88%
Small River, Low Gradient, Cool	6	0.48%	15.63%
Small River, Low Gradient, Warm	5	0.41%	1.11%
Small River, Moderate Gradient, Cool	46	3.72%	9.88%
Small River, Moderate Gradient, Warm	45	3.65%	8.31%
Medium River, Low Gradient, Warm	34	2.76%	7.19%
Medium River, Moderate Gradient, Warm	58	4.66%	16.62%
Totals	1,237	100.00%	

Aquatic Habitat



Species of Greatest Conservation Need

The table below lists the number SGCN in each taxa group listed in the SWAP for the Cacapon River and Patterson Creek CFA (see full list in Appendix 1).

Species Summary by Taxa and Priority

TAXA	# SGCN
Amphibians	18
Birds	44
Butterflies and Moths	14
Cave Invertebrates	7
Dragonflies and Damselflies	28
Fish	12
Mammals	5
Mussels	13
Plants	75
Reptiles	14
Snails	9
Tiger Beetles	1
Totals	240

In this CFA, stream and riparian habitats are important for many SGCN restricted in West Virginia to the Potomac Basin including Wood turtles and Spotted turtles, Harperella (a plant listed as *endangered* under the Endangered Species Act), 12 fish species and 13 mussel species (all SGCN). Headwater tributaries in both Cacapon River and Patterson Creek, although at low elevations, are cold water streams that support native Brook Trout populations. Streams and wetlands in the CFA support 28 dragonflies and damselflies SGCN (an unusually large number for West Virginia).

These watersheds also include shale barrens that support associated endemic plants and lepidopterans including 14 SGCN moths and butterflies. This is also an important CFA for birds, including 44 SGCN. Pastures and hayfields are important for several grassland bird species. Upland forests, especially larger intact forest blocks on the national forest, support a suite of forest interior bird species.

Altogether, the CFA supports 75 SGCN plants. The algific talus community (which holds subsurface ice into the summer) at Ice Mountain is a notable refugium for rare plants and snails, and the extensive, high quality wetlands on Short Mountain WMA are of global significance.

This Action Plan will list the priority SGCN in each major habitat type in the CFA.

Distinctive Stresses

The 2015 SWAP lists several general stresses affecting SGCN and habitat in this CFA:

- Development pressure is significant in the Cacapon Watershed, with substantial residential and second home development, especially along major streams and adjacent to public land.
- Water quality impacts from agriculture and development exist throughout both watersheds.
- Fragmenting intact forests increases surface water temperatures (and consequently headwater stream temperatures) and storm water run-off.

In addition to this list of general stresses, this Action Plan will list more specific local stresses affecting priority SGCN in each major habitat type.

Conservation Actions

To address these stresses, the 2015 SWAP recommended that four main types of action in the CFA:

1. Promote practices for restoring riparian habitat, including streamside fencing and establishing riparian buffers, and for reducing sedimentation and nutrient runoff from farms.
2. Coordinate with the active land trust and farmland protection community to protect habitat through land conservation.
3. Engage public landowners to maintain large, intact forest blocks thus protecting many other special habitats. Develop forest management plans.
4. Implement a plan to enhance climate change resiliency through reducing other stressors (such as invasive species), identifying, maintaining, and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity.

These four broad actions are integrated into this Action Plan along with more specific conservation actions to address the stresses affecting priority SGCN in each major habitat type.

Potential Partners

The 2015 SWAP lists many potential partners for landowners and others interested in wildlife conservation in the CFA, including:

- WV Division of Forestry,
- WV Department of Environmental Protection,
- USDA- Natural Resource Conservation Service,
- West Virginia Conservation Agency,
- County Farmland Protection Boards,
- The Cacapon and Lost Rivers Land Trust,
- Friends of the Cacapon,
- The Cacapon Institute, and
- Potomac Conservancy.

With an established “constituency”, many conservation partners can provide direct outreach to landowners and key stakeholders interested in wildlife conservation. The WVDNR will engage with these and other partners in regular meetings and planning workshops during CFA planning,

implementing conservation actions, and monitoring effectiveness. In many cases partners may assume a lead role in implementation. Appendix 1 lists the types of programming and assistance each partner provides to landowners. Specific partners are also listed along with conservation actions supported through their programs in the implementation plan for each habitat type.

Protected Lands

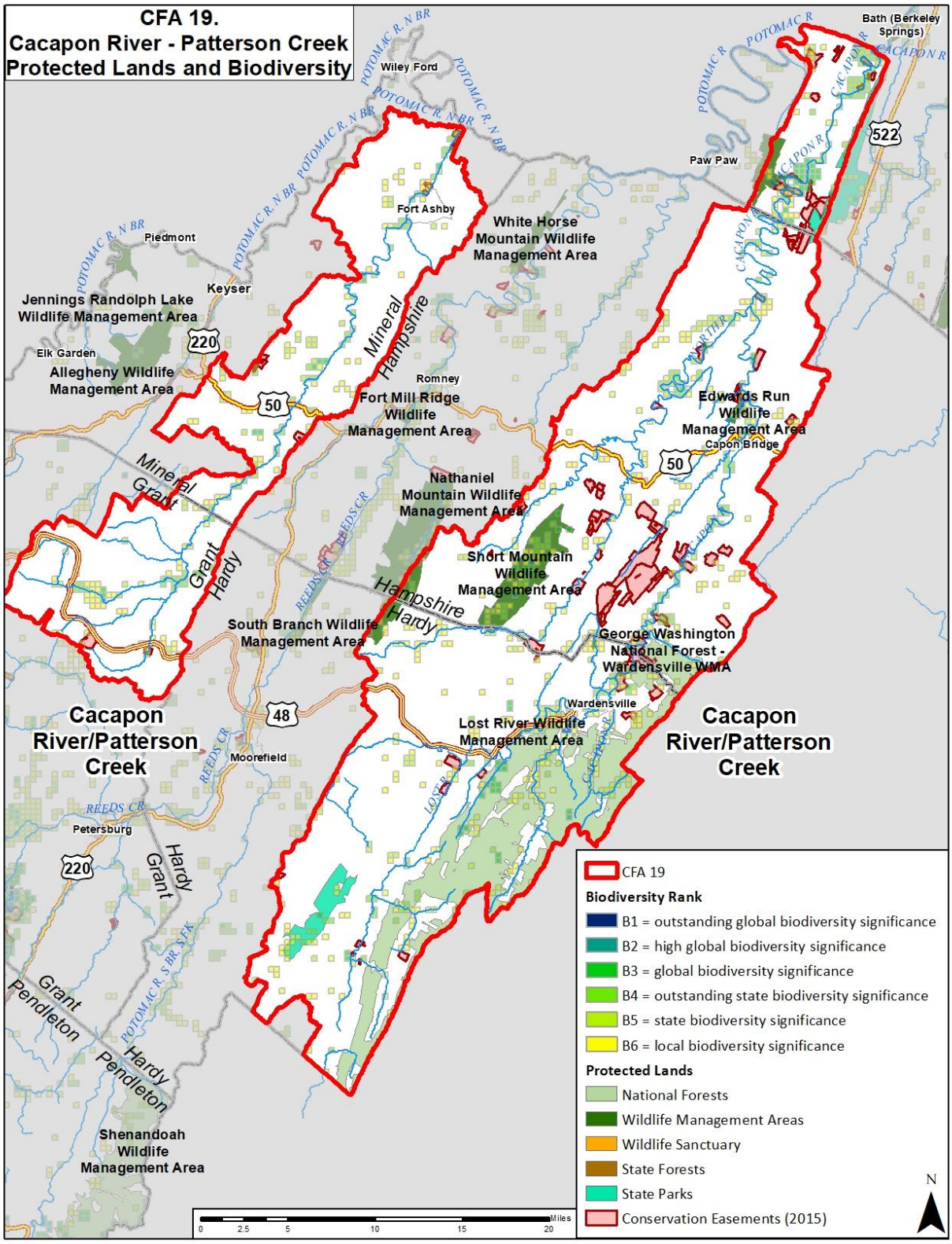
Public lands that can provide significant opportunities for wildlife conservation include:

- George Washington National Forest
- Cacapon and Lost River State Parks
- Short Mountain, Edwards Run, Nathaniel Mountain, and Sideling Hill WMAs

These public lands provide important wildlife habitat and are managed for conservation or other compatible goals. Appendix 3 lists habitat types occurring in each of the public lands within this CFA. WVDNR will work with public land managers to identify opportunities to plan and implement conservation actions that address stresses in these habitats and support priority SGCN. WVDNR will work with public land managers to identify opportunities to plan and implement conservation actions that address stresses in these habitats and support priority SGCN. On state lands, this may include protection of important ecosystems, habitats, SGCN populations or plant communities through designation as State Natural Areas. City and county-owned public lands may also be managed to benefit wildlife and habitat. In addition, land trusts and conservation organizations including the Cacapon and Lost River Land Trust and the Potomac Conservancy, as well as The Nature Conservancy, the county farmland protection boards, the USDA Natural Resources Conservation Service and WV Division of Forestry's Forest Legacy Program hold conservation easements on private lands that may protect important wildlife habitat and provide additional wildlife conservation opportunities.

The next map shows the location of public lands and conservation easements in the CFA, based on data provided by The Conservation Fund (TCF), USGS Gap Analysis Program (GAP), The Nature Conservancy (TNC), and the National Conservation Easement Database (NCED) in 2015. It also shows known occurrences of SGCN and rare plant communities within 500- square meter areas, and the biodiversity rank (including global, state, or local significance) of those occurrences, as generated by WVDNR in 2017. This map illustrates that many SGCN and rare plant communities occur on public lands and conservation easements in the CFA, and there may be opportunities for WVDNR, public agencies and landowners to protect them there. Many SGCN and rare plant communicates also occur on private land outside of public lands and conservation easements. This indicates how important it is for WVDNR and other partners to work with private landowners to restore and protect biodiversity on private lands. Appendix 4 lists partners and programs that provide assistance to private landowners in wildlife conservation.

Protected Lands and Biodiversity



Action Plan for the Conservation Focus Area

Conservation Goals

The Cacapon River/Patterson Creek CFA Action Plan is an extension of the State Wildlife Action Plan. While it is driven by local issues, the overarching goals remain the same. These include:

1. Halt the decline of at-risk species and thus avoid the need for federal listing as threatened or endangered
2. Assist with the recovery of federally listed species
3. Keep the common species common
4. Conserve the full array of habitat types and biological diversity in the state

The WVDNR will develop relationships with conservation partners and key stakeholders to support and promote natural resource stewardship and guide efforts that protect, restore, enhance, and otherwise benefit natural communities and processes. Only through collaboration with agency partners, non-governmental organizations and the public can we address threats to Species of Greatest Conservation Need, key habitats, and unique communities.

Priority Species

Effectiveness and efficiency are paramount in targeting actions in CFAs and specifically addressing every SGCN present in the CFA is not feasible. From the list of SGCN present in the CFA provided in the SWAP, WVDNR wildlife biologists selected priority species for conservation action that represent the best opportunity for successful conservation based on its population status and known trends in the CFA, the significance of each species at the global, state and local levels, the degree of dependence of each species on habitats within the CFA, conservation opportunities and likelihood of conservation success in the CFA, and other factors. The table below lists SGCN that were selected as priority species within the CFA based on the above criteria. Also listed are the priority species which are classified as rare, threatened or endangered species or as sensitive species by United States Forest Service's Region 8 and as at risk species by the United States Fish and Wildlife Service, indicating that the agencies may target these species for conservation action and may provide additional technical and financial support. Additional field surveying and information is needed to document and monitor the distribution, abundance, and population trends of these priority species in the habitats where they occur, and to assess their vulnerability to climate change. This work is ongoing and will be included as an action in the implementation plan for each major habitat type that follows.

Priority Species in CFA

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK	USFS R8	USFWS
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5		
Birds	Aquila chrysaetos	Golden Eagle	S3N	G5		
Birds	Falco sparverius	American Kestrel	S3B	G5		
Birds	Colinus virginianus	Northern Bobwhite	S1B, S1N	G5		

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK	USFS R8	USFWS
Birds	Scolopax minor	American Woodcock	S3B	G5		
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5		
Birds	Tyto alba	Barn Owl	S2B, S2N	G5		
Birds	Chaetura pelagica	Chimney Swift	S3B	G5		
Birds	Riparia riparia	Bank Swallow	S2B	G5		
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5		
Birds	Lanius ludovicianus migrans	Migrant Loggerhead Shrike	S1B, S1N	G4T3Q		
Birds	Setophaga discolor	Prairie Warbler	S3B	G5		
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4		
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5		
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5		
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5		
Birds	Spizella pusilla	Field Sparrow	S3B	G5		
Birds	Pooecetes gramineus	Vesper Sparrow	S2B, S2N	G5		
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5		
Birds	Dolichonyx oryzivorus	Bobolink	S3B	G5		
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5		
Fish	Anguilla rostrate	American Eel	S2	G4		
Fish	Salvelinus fontinalis	Brook Trout	S5	G5		
Fish	Notropis procne	Swallowtail Shiner	S1	G5		
Fish	*Cyprinella analostana*	*Satinfin Shiner*	*S1*	*G5*		
Fish	Luxilus cornutus	Common Shiner	S1S2	G5		
Reptile	Clemmys guttata	Spotted Turtle	S1	G5	S	At Risk
Reptiles	Glyptemys insculpta	Wood Turtle	S3	G4	S	At Risk
Cave Invertebrates	Stygobromus franzi	Franz's Cave Amphipod	S1	G3G4		
Cave Invertebrates	Stygobromus allegheniensis	Allegheny Cave Amphipod	S1	G5		
Cave Invertebrates	Stygobromus morrisoni	Morrison's Cave Amphipod	S1	G2G3		At Risk
Cave Invertebrates	Onychiurus janus	A Cave Springtail	S1	G2G3		
Cave Invertebrates	Zygonopus krekeleri	West Virginia Blind Cave Millipede	S1	G4		
Dragonflies & Damselflies	Gomphus abbreviatus	Spine-crowned Clubtail	SH	G3G4		
Dragonflies & Damselflies	Macromia alleghaniensis	Allegheny River Cruiser	S2S3	G4		
Dragonflies & Damselflies	Libellula flavida	Yellow-sided Skimmer	S3	G5		
Dragonflies & Damselflies	Calopteryx angustipennis	Appalachian Jewelwing	S3	G4		

TAXA	SCIENTIFIC NAME	COMMON NAME	S RANK	G RANK	USFS R8	USFWS
Mussel	Alasmidonta undulata	Triangle Floater	S1	G4		
Mussel	Alasmidonta varicosa	Brook Floater	S2	G3	S	At Risk
Mussel	Lampsilis cariosa	Yellow Lampmussel	S2	G3G4	S	
Mussel	Lasmigona subviridis	Green Floater	S2	G3	S	At Risk
Plants	Ptilimnium fluviatile	Harperella	S1	G2	E	
Plants	Lupinus perennis ssp. Perennis	Wild Lupine, Sundial Lupine	S1	G5T4		
Plants	Scirpus ancistrochaetus	Barbed-bristle Bulrush	S1	G3	E	
*Plants	*Trifolium reflexum*	*Buffalo Clover*	*S1*	*G3G4*		
*Plants	*Carex davisii*	*Davis' Sedge*	*S1*	*G4*		
*Plants	*Xerophyllum asphodeloides*	*Eastern Turkeybeard*	*S1*	*G4*		

**These species may be extirpated, their status and location are unknown and will require surveying*

S = sensitive species, E= endangered species

Forest and Woodland Habitats

Dry Mesic Oak Forests cover about one half of the CFA and represent the largest portion of forest habitat types, followed by Dry Oak Pine Forests. Dry Calcareous Forests, Woodlands and Glades and Pine-Oak Rocky Woodlands occupy smaller portions of the CFA but represent over 15% of those forest habitat types in the state. Smaller portions of forested areas are composed of Mixed Mesophytic Forests, Montane Red Oak Forests on some high ridge tops, and Northern Hardwood Forests. The following pages include maps of forest habitat types, and intact forest patches (based on the Appalachian and Mid-Atlantic Forest Patch Dataset compiled by The Nature Conservancy in 2011) with biodiversity. The diversity of forest types across elevational gradients provides great opportunities for their conservation within larger forest patches and requires careful management tied to specific site conditions and forest stand characteristics. Intact forest patches provide core habitat for a significant portion of the SGCN and rare communities, as well as a matrix of forest habitat types and large corridors within which forest species may shift and adapt to climate change.

Priority Species

The table below lists priority species in the CFA associated with forest and woodland habitats.

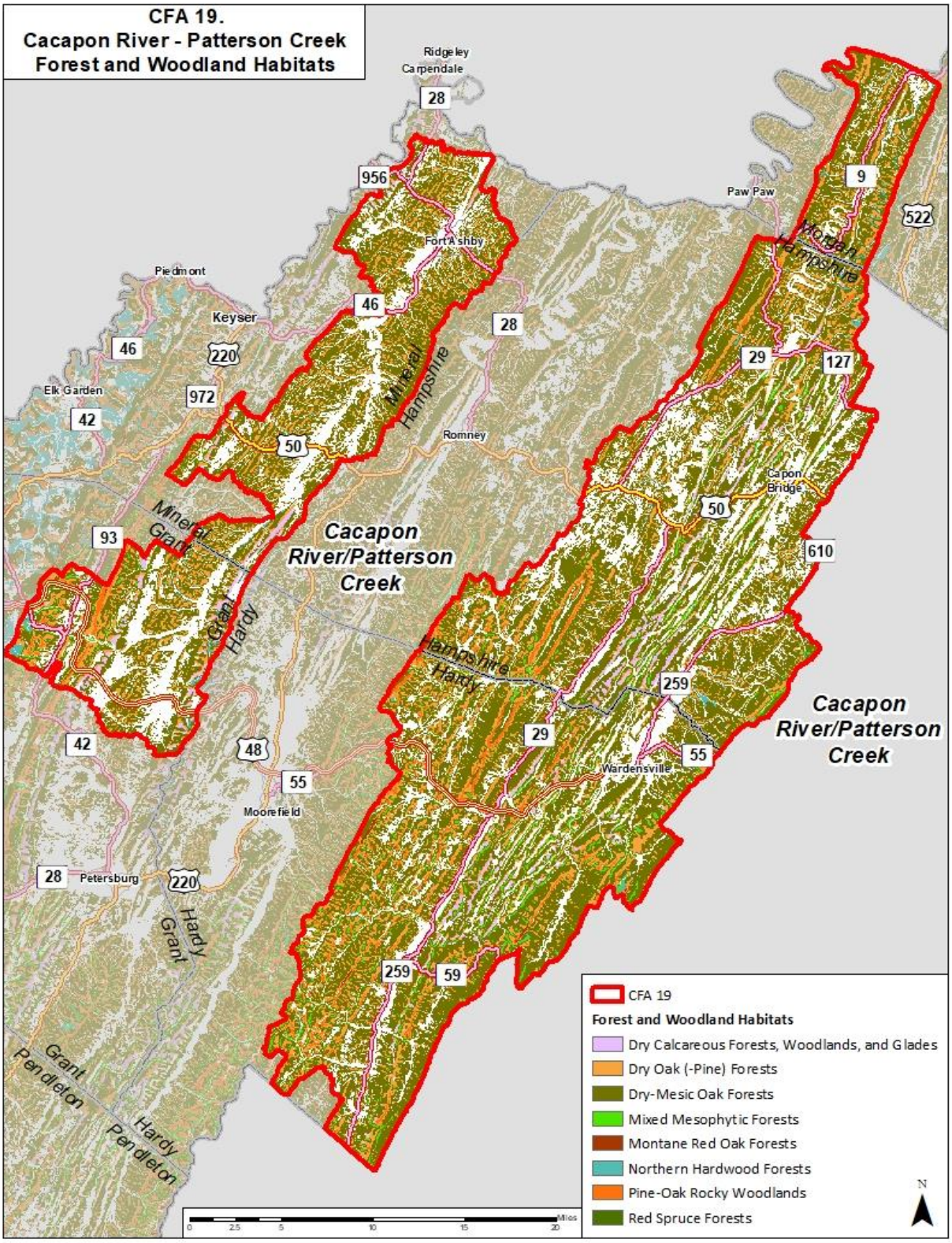
Priority Species in Forest and Woodland Habitats.

TAXA	SCIENTIFIC NAME	COMMON NAME
Birds	Buteo platypterus	Broad-winged Hawk
Birds	Aquila chrysaetos	Golden Eagle
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo
Birds	Hylocichla mustelina	Wood Thrush
Birds	Setophaga discolor	Prairie Warbler
Birds	Helmitheros vermivorum	Worm-eating Warbler
Birds	Setophaga cerulea	Cerulean Warbler
Reptiles	Glyptemys insculpta	Wood Turtle
Plants	Lupinus perennis ssp. perennis	Wild Lupine, Sundial Lupine
*Plants	*Xerophyllum asphodeloides*	*Eastern Turkeybeard*
*Plants	*Trifolium reflexum*	*Buffalo Clover*

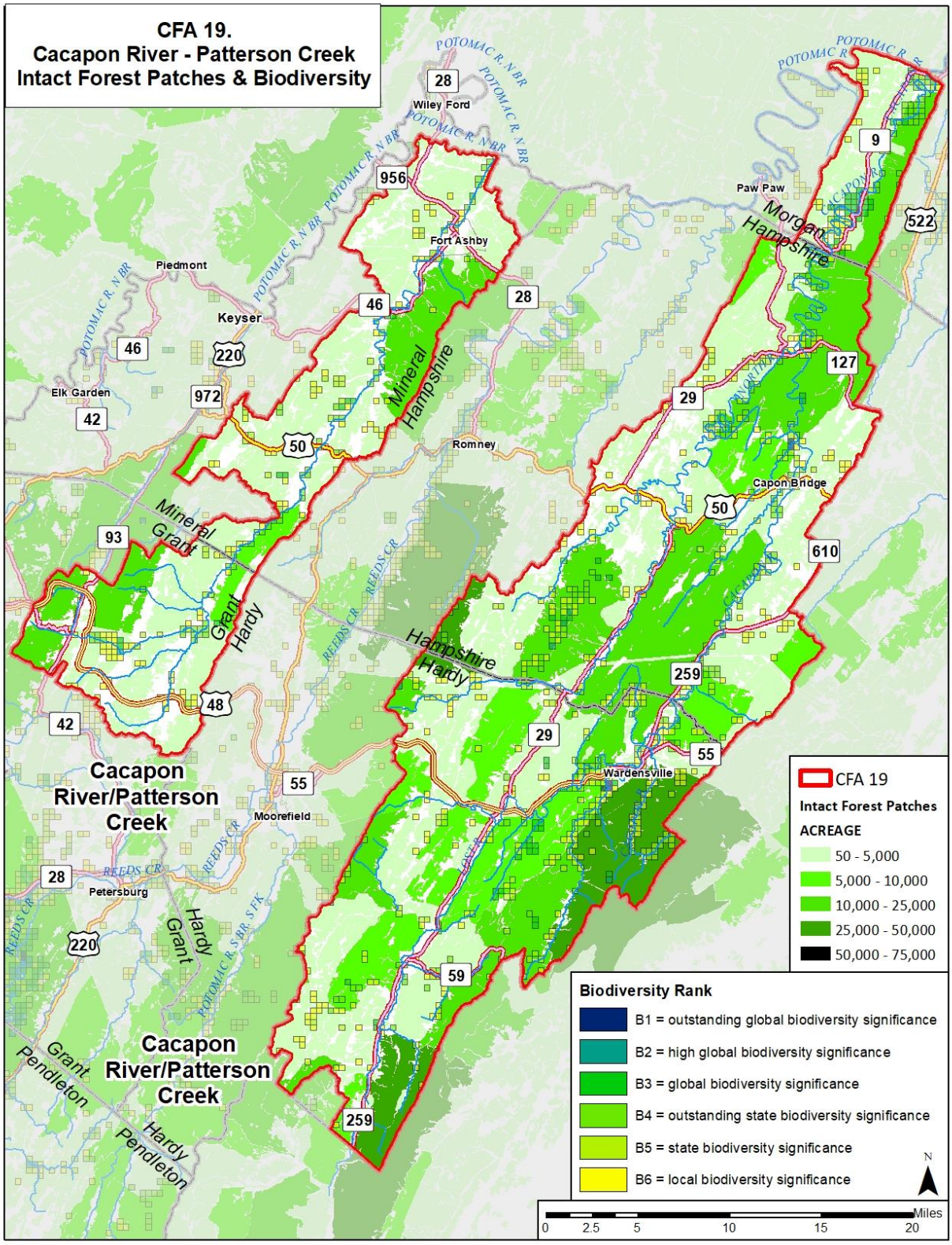
**These species may be extirpated; their status and location are unknown and requires surveying.*

Several priority bird species rely on Dry Mesic Oak Forests, which occupy the largest portion of the CFA. Several rare plant species are associated with Pine-Oak Rocky Woodlands and Dry Oak-Pine Forests, but additional surveying will be required to ascertain their status and location. Large forest patches provide core habitat for forest interior breeding birds, including Broad-winged Hawk, Wood Thrush, Cerulean Warbler and Worm-eating Warbler. Early successional habitats support Prairie Warbler, and Black-billed Cuckoo. Wood turtles rely on forested as well as aquatic habitats for different parts of their life history. They also rely on connections between those habitats for passage between them.

Forest and Woodland Habitats



Intact Forest Patches and Biodiversity



Rare Plant Communities

Dry Mesic Oak Forests and Calcareous Forests, Woodlands and Glades host several rare plant communities in this CFA. Note that over half of the state's Eastern Ridges Oak-Hickory-Graminoid Forest are located here. These communities are vulnerable to disturbance by logging and grazing activities, and to the spread of non-native invasive plants. Disturbance should be avoided, and non-native invasive plant infestations should be treated.

Rare Plant Communities in Forest and Woodland Habitats.

HABITAT	COMMON NAME	G RANK	S RANK	RELALATIVE ABUNDANCE
Dry Calcareous Forests, Woodlands, and Glades	Ridge and Valley Sugar Maple - Chinquapin Oak Dry Limestone Woodland	G4?	S2	17%
Dry Calcareous Forests, Woodlands, and Glades	Calcareous Shale Prairie Woodland	G2	S1	15%
Dry-Mesic Oak Forests	Eastern Ridges Oak - Hickory / Graminoid Forest	G3G4	S3	52%

Habitat Stresses and Conservation Actions

The table below lists stresses impacting species in forest and woodland habitats, and conservation actions landowners and partners can take to address those stresses.

Habitat Stresses and Conservation Actions in Forest and Woodland Habitats:

Habitat Stress	Conservation Action
Forest habitat fragmentation	Habitat protection to maintain large forest blocks, and forested corridors for wildlife passage between watersheds. • Land use planning by local governments • Land protection/conservation easements
Early successional forest: Insufficient habitat, forest maturation and poor forest structure	Develop and implement forest management plans that create or maintain early successional habitat to benefit wildlife species through forest management activities on appropriate sites
Interior forests: Insufficient habitat, poor forest structure	Develop and implement forest management plans that improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites
Non-native invasive weeds	Prevent spread through forestry operations and other ground disturbance, conduct monitoring and treatment
Pesticide exposure	Reduce aerial application of agricultural pesticides
Deer overbrowse, poor forest structure	Reduce deer population

Habitat Stress	Conservation Action
Herbicide use and veg. management in utility corridors	Manage utility corridors to reduce wildlife impacts
Lack of fire and woody encroachment in Pine-Oak Rocky Woodlands	Create forest canopy gaps, and prescribed burning on public lands

In addition to the habitat-linked stresses listed above, direct stresses to priority species include insecticides poisoning Black-billed Cuckoos.

While efforts to manage and restore both early successional and interior forest habitat are needed for priority SGCN, restoration efforts should not convert one to the other. Early successional forest habitat forest restoration should take place in small patches of forest and along forest edges. Existing young forests can be enhanced outside of large blocks of interior forest. And efforts to restore and expand interior forest blocks should not generate an overall loss of early successional forest.

Climate Change and Habitat Resilience

The Central Appalachian Forest Ecosystem Vulnerability Assessment (Butler et. al, 2015) described many potential impacts of climate change on forests in the region. Likely impacts include increased temperatures (especially during the summer and fall), a decrease in winter snowpack, longer growing seasons, increased precipitation during spring and even greater decreases in precipitation during summer and fall, more frequent heavy precipitation events, and increasing frequency and severity of storms. These impacts will likely lead to changing soil moisture patterns, increased risk of wildfire, increased damage from pests and pathogens, and increased extent and abundance of invasive plants. Habitat for northern species is likely to decline, although species such as red spruce may persist in cool, wet microclimates. Tree seedlings will likely be more vulnerable to climate change impacts than mature trees. Forest ecosystems lacking a diversity of species, age classes and genotypes may be at greater risk from climate change than those with greater diversity. Forest species in fragmented landscapes will have less opportunity to migrate across the landscape in response to changing conditions, and ecological communities tied to specific hydrological conditions or geologic features may also be unable to migrate. Urban areas and impervious cover can exacerbate the effects of increasing temperatures and heavier precipitation. However, ecosystems within areas of high landscape complexity, including a diversity of topography and microhabitats, may be more able to persist and adapt in response to climate change.

The 2015 assessment also described likely impacts to specific forest types. Dry Mesic Oak Forests support of large number of tree species over a diversity of terrain, and many of the tree species are tolerant of drought and fire, providing some resilience to climate change. Fire suppression and timber harvesting have allowed more mesic species to become dominant. But increased temperature and drought could increase the risk of wildfire. While low-intensity fires could restore fire-adapted species, severe fires, combined with drought and other stressors, could increase mortality of some species. Higher temperatures and drought may increase the susceptibility of these forests to invasive species, pests and pathogens, and drought as well as disturbances from stronger storms may enable the spread of non-native invasive plants.

Dry Oak Pine Forests and Pine-Oak Rocky Woodlands are adapted to heat, drought and fire. While moderate increases in these drivers could benefit this forest type, severe drought and fire could lead to increased mortality of tree species. Droughts may increase susceptibility to forest pests and pathogens and enable non-native invasive plants to outcompete native herbs and shrubs, providing additional fuel for fires and increasing fire intensity. Forest pests, pathogens and invasive plants need to be carefully managed to build resilience to climate change.

Dry Calcareous Forests, Woodlands and Glades are adapted to heat, drought and wildfire, but may be impacted by increased fire intensity, correlated with increases in invasive plant species. Management of invasive plants will be critical for the long-term resilience of the ecosystem. Dependence on unique soils may impede the ecosystem's ability to shift across the landscape.

Mixed Mesophytic Forests may be vulnerable to increasing disturbance by wildfire, drought and invasion by non-native plants. These ecosystems may decline in some areas, while sheltered sites in areas of complex topography may provide some refuge from climate change. Drought may increase the susceptibility of these forests to hemlock woolly adelgid, forest tent caterpillar, beech bark disease and other insect pests and diseases. Invasive plants may outcompete native species as conditions change, and drought may increase the risk of wildfire, to which these forests are not well adapted.

The small areas of northern hardwood forests may be particularly impacted by climate change. Increased heat and moisture stress in summer and fall may interact with acid deposition as well as increases in insect pests and pathogens, storm disturbance and wildfires to stress these forests, reducing species diversity and coverage. Cool, moist sites within areas of complex topography may provide some refuge and buffer the effects of climate change.

Some changes in forest composition and structure are likely to occur over time as these different forest types adapt and adjust in response to changes in climate. Conservation actions to reduce existing stresses on forests will aid in building their resilience. Protection of large forest patches in areas with complex topography and diverse microclimates, and maintaining forested connections between them, may further enable their adaptation and shifting distribution across the landscape.

Below is a summary of climate stresses on forest habitats, and actions which could boost their resilience (Swanston et al, 2016). While climate stresses are listed separately, forest and woodland habitats are often impacted by a multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions resemble previously listed conservation actions to reduce stress on priority species, meaning that they could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners may select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Climate Stresses and Resilience Actions in Forest and Woodland Habitats

Climate Stresses	Habitat Resilience Actions
• Increased spring and summer temperatures • Increased risk of drought and wildfire • Increased frequency and severity of storms, • Increased competition from non-native invasive species, pests, and pathogens	• Restore or maintain fire in fire-adapted ecosystems • Manage deer herbivory to promote regeneration • Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Promote diversity of native species and age classes through planting and silviculture • Protect habitat refugia for rare plant communities and forest types dependent on unique soils, such as calcareous forests, woodlands, and glades • Protect forest reserves in areas of high biological diversity or priority species • Reduce forest fragmentation • Maintain or restore large patches and corridors of forest habitat • Restore native forest vegetation on degraded lands within and adjacent to forested areas

Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement, and measure the effectiveness of conservation actions to benefit priority species in forest and woodland habitats.

Implementation Plan for Forest and Woodland Habitats

Action	Partners /Programs	Effectiveness Measures
Habitat Protection: • Conservation Easements	• WVDOF Forest Legacy • County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust • The Nature Conservancy	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Habitat Protection: • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning for development around cliffs, steep slopes and fragile soils

Action	Partners /Programs	Effectiveness Measures
Habitat Protection • Incentive Programs	• USDA NRCS CSP	• Acres of habitat protected for priority species • Abundance and diversity of priority species and habitats
Develop and implement forest management plans that create or maintain early successional habitat to benefit wildlife species through forest management activities on appropriate sites	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters • NWTF and RGS • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Develop and implement forest management plans that improve or maintain interior forest habitat to benefit wildlife species through forest management activities on appropriate sites	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Control invasive weeds	• WVDOF • WVCA and Conservation District • NRCS CSP & EQIP • Public Land Managers	• Acres of habitat protected or restored for priority species • Before and after comparison: abundance & distribution of priority species
Reduce aerial application of pesticides (to control caterpillars)	• Landowners/orchards	• Change in pesticide use • Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species

Action	Partners /Programs	Effectiveness Measures
Manage deer browse and reduce deer population	• Private landowners • Hunting • WVDNR (hunting licenses) • WVDNR Wildlife Management Areas • National Forests	• Change in deer population • Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	• Public Land Managers • Partners • Utility companies	• Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Maintain forest corridors for wildlife passage between watersheds.	• USDA NRCS EQIP • USDA FSA CRP, CREP • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOF • WVDEP and WVCA	• Acres or linear feet of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Create forest canopy gaps (Pine Oak Rocky Woodlands)	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Promote diversity of native species and age classes in forested areas, and restore native forest vegetation on adjacent degraded lands through planting and silviculture	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species

Action	Partners /Programs	Effectiveness Measures
Prescribed burning by public agencies to restore fire adapted ecosystems (e.g. Pine- Oak Rocky Woodlands)	• State Forests and Wildlife Management Areas • US Forest Service	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Landowner outreach and habitat protection demonstration projects	• Cacapon and Lost Rivers Land Trust • Friends of Cacapon • Wildlife Management Areas	• # landowners reached • resulting # practices or acres enhanced

Human Benefits

Actions to restore and protect forest and woodland habitat may provide human health and economic benefits for local residents and communities. These benefits include protection of water ways, water quality and drinking water sources, reduced flood damages, long-term timber production, forest carbon opportunities, and hunting, wildlife viewing, tourism, and recreational opportunities.

Rock Outcrops, Cliffs and Talus, and Shale Barrens

Acidic Rock Outcrops, Cliffs and Talus, Calcareous Cliffs and Talus, and Shale Barrens cover small areas within the CFA, and are threatened by non-native invasive plants, woody encroachment, quarrying and other development. A map illustrating the location of these rare habitat types is on the following page, and those in smaller forest patches may be more vulnerable to stresses. These habitat types, while covering only small areas, are priorities for the conservation of rare plant communities in this CFA.

Rare Plant Communities

Although there are no priority SGCN selected for these habitats, Shale Barrens and Acidic Rock Outcrops, Cliffs and Talus habitats provide core habitats for several rare plant communities, listed below. Over 40% of statewide occurrences of these communities are found in this CFA. These habitat types, while covering only small areas, are priorities for the conservation of rare plant communities in this CFA. Additional field surveying is needed to better understand and monitor the distribution and abundance of these rare communities.

Rare Plant Communities in Acid Rock Outcrops and Shale Barrens

HABITAT	COMMON NAME	G RANK	S RANK
Acidic Rock Outcrops, Cliffs, and Talus	Basswood Boulderfield Forest	G3	S1S2
Acidic Rock Outcrops, Cliffs, and Talus	Sandstone Boulderfield Lichen Community	G5	S3
Shale Barrens	Northern Ridge and Valley Shale Barren	G3	S3
Shale Barrens	Calcareous Shale Prairie Woodland	G2	S1

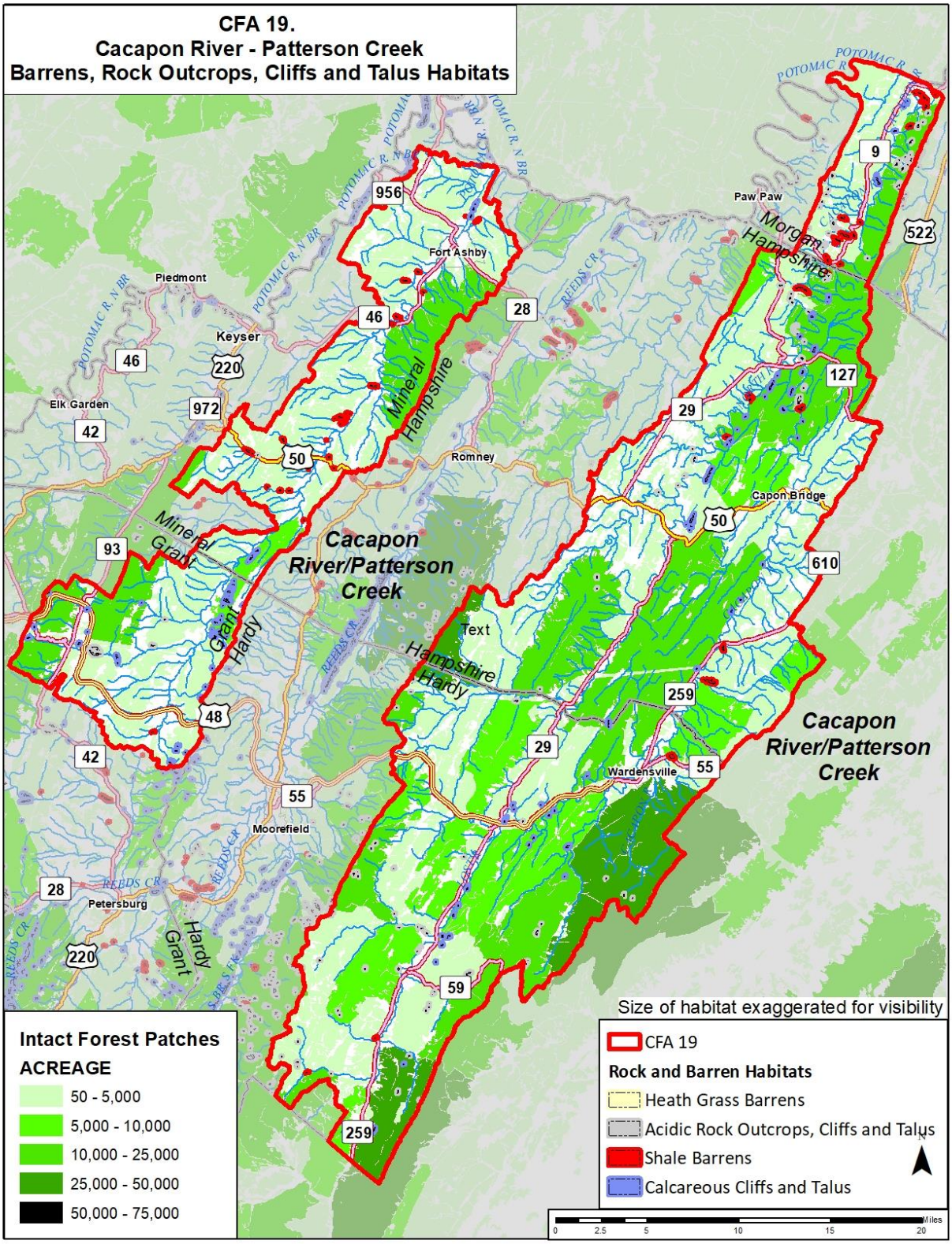
Habitat Stresses and Conservation Actions

The following stresses to these sensitive habitats may be addressed through the actions below.

Habitat Stresses and Conservation Actions in Rock Outcrop, Cliff and Talus, and Shale Barren Habitats

Habitat Stress	Conservation Action
Non-native invasive plants	Targeted treatment of non-native invasive plants
Woody Encroachment; Lack of Fire	Create and maintain openings in forest canopy; Controlled burning by public agencies
Recreation and trampling	Manage recreation on sensitive sites
Quarries & development	Minimize impact on fragile habitat

Rock Outcrops, Cliffs and Talus, and Shale Barren Habitats



Climate Change and Habitat Resilience

As described in The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et. al, 2015), ecosystems that are limited by geological features may be restricted from shifting across the landscape in response to climate change. Acidic rock outcrops, cliffs and talus and shale barren habitats are dependent on underlying geology, so their ability to shift across the landscape in response to climate change is very limited. While they are usually adapted to extreme conditions, they may be vulnerable to increased disturbance from drought, fire and storms, and from invasion by non-native invasive plants. Protecting and maintaining intact forest ecosystems around these rare habitats, and controlling invasive species, may help maintain resilience in a changing climate.

Climate Stresses and Resilience Actions in Rock Outcrop, Cliff and Talus, and Shale Barren Habitats

Climate Stresses	Habitat Resilience Actions
• Increased risk of drought and wildfire • Increased frequency and severity of storms • Increased competition from non-native invasive species	• Promptly revegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Protect refugia for rare habitats and plant communities • Maintain intact, resilient forest habitat in surrounding areas

Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement and measure the effectiveness of conservation actions to benefit priority species in shale barrens, acid rock outcrops, and calcareous cliffs and talus.

Implementation Plan for Rock Outcrop, Cliff and Talus, and Shale Barren Habitats

Action	Partners /Programs	Effectiveness Measures
Habitat Protection: • Conservation Easements	• WVDOF Forest Legacy • County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust	• Acres of habitat protected for priority species • Abundance & distribution of priority species and habitats
Habitat Protection: • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning for development around cliffs, steep slopes and fragile soils

Action	Partners /Programs	Effectiveness Measures
Habitat Protection • Incentive Programs	• USDA NRCS CSP	• Acres of habitat protected for priority species • Abundance & distribution of priority species and habitats
Re-vegetate sites after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species	• WVDOF • WVCA and Conservation District • NRCS CSP • Public Land Managers • Private Landowners	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Create and maintain openings in forest canopy	• WVU Extension • USDA NRCS EQIP • WVDOF • Consulting Foresters • Public Land Managers	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Prescribed burning by public agencies to restore fire adapted plant communities	• State Forests • Wildlife Management Areas • US Forest Service	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Manage recreation on sensitive sites	• Public Land Managers • WVDNR	• Acres of habitat restored for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Minimize impact on fragile habitat	• Quarries and developers • Public Land Managers	• Acres of habitat protected for priority species • Before and after comparison: abundance, diversity and distribution of priority species
Landowner outreach and habitat protection demonstration projects	• Cacapon and Lost Rivers Land Trust • Friends of Cacapon	• # landowners reached • resulting # practices or acres enhanced

Human Benefits

Actions to restore rock outcrop, cliffs and talus, and shale barren habitat may provide human health and economic benefits for local residents and communities, including hunting, wildlife viewing, tourism, and recreational opportunities.

Aquatic, Floodplain and Riparian Habitats

A diversity of aquatic habitats in the CFA range from cold, high-gradient headwater streams to warm, low gradient, medium sized rivers such as the lower sections of Cacapon River and Patterson Creek. A map of aquatic habitat types is included in the introduction to the CFA. These streams and river habitats are tightly connected with their adjacent floodplains, wetlands and riparian habitats. Many wildlife species rely on aquatic habitats such as streams, rivers, and wetlands, as well as their adjacent terrestrial habitats, especially riparian areas and forests. Substantial portions of floodplain have been cleared for settlement and agriculture. The loss of natural floodplain habitats and riparian corridors often impacts water quality and adjacent aquatic habitat. And improving wildlife habitat in streams and rivers often requires conservation actions to improve adjacent floodplain and riparian habitats. Therefore aquatic, floodplain, wetland and riparian habitats will be addressed together.

Priority Species

The table below lists priority aquatic species in the CFA that occur in rivers and streams. This CFA contains more than half of the state's occurrences of several species of mussel including Triangle Floater, Brook Floater, Yellow Lampmussel, as well as half of the state's Wood Turtles and Spotted Turtles and at least 50% of three Dragonfly and Damselfly species: Yellow-sided Skimmer, Splendid Clubtail, and Spine-crowned Clubtail. Spotted Turtles also rely on adjacent wetland habitats.

Priority Aquatic Species

TAXA	SCIENTIFIC NAME	COMMON NAME
Reptile	Glyptemys insculpta	Wood Turtle
Reptile	Clemmys guttata	Spotted Turtle
Dragonflies & Damselflies	Libellula flavida	Yellow-sided Skimmer
Dragonflies & Damselflies	Gomphus lineatifrons	Splendid Clubtail
Dragonflies & Damselflies	Gomphus abbreviatus	Spine-crowned Clubtail
Dragonflies & Damselflies	Macromia alleghaniensis	Allegheny River Cruiser
Dragonflies & Damselflies	Calopteryx angustipennis	Appalachian Jewelwing
Mussel	Alasmidonta undulata	Triangle Floater
Mussel	Lasmigona subviridis	Green Floater
Mussel	Alasmidonta varicosa	Brook Floater
Mussel	Lampsilis cariosa	Yellow Lampmussel
Fish	Luxilus cornutus	Common Shiner
Fish	Notropis procne	Swallowtail Shiner
*Fish	*Cyprinella analostana*	*Satinfin Shiner*
Fish	Anguilla rostrata	American Eel
Fish	Salvenlinus fontinalis	Brook Trout

**These species may be extirpated; their status and location are unknown and will require surveying.*

Depression ponds and wetlands are classified as terrestrial habitats but are often tied to the hydrology of aquatic habitats and host similar species. The Yellow-sided Skimmer is a dragonfly/damselfly that relies on warm, low-gradient headwater streams as well as High Allegheny wetland habitats. And Bristle-brush Bulrush is associated with sinkholes and depression ponds. Like other aquatic environments, ponds and wetland habitats are influenced by land use practices in adjacent lands and waters.

Priority Species in Depression Ponds and Wetlands

TAXA	SCIENTIFIC NAME	COMMON NAME
Plants	Scirpus ancistrochaetus	Barbed-bristle Bulrush
Dragonflies and Damselflies	Libellula flavida	Yellow-sided Skimmer

Although riparian and floodplain habitats are classified as terrestrial, they are closely connected to adjacent rivers and streams and host some of the same species, including Wood Turtles, Splendid Clubtails and Appalachian Jewelwings. Louisiana Waterthrush and Bank Swallows both rely on riparian and floodplain and habitats, as do rare plants including Harperella and Davis' Sedge, the current status of which is unknown. The table below lists the priority species associated with small stream riparian and river floodplain habitats.

Priority Riparian and Floodplain Species

TAXA	SCIENTIFIC NAME	COMMON NAME
Birds	Parkesia motacilla	Louisiana Waterthrush
Birds	Riparia	Bank Swallow
Reptiles	Glyptemys insculpta	Wood Turtle
Dragonflies and Damselflies	Gomphus lineatifrons	Splendid Clubtail
Dragonflies and Damselflies	Gomphus abbreviatus	Spine-crowned Clubtail
Dragonflies and Damselflies	Calopteryx angustipennis	Appalachian Jewelwing
*Plants	*Carex davisii*	*Davis' Sedge*
Plants	Ptilimnium fluviatile	Harperella

**These species may be extirpated; their status and location are unknown and will require surveying.*

Rare Plant Communities

The following rare plant communities may be found in aquatic, floodplain and riparian habitats in this CFA. Note that all the state's Ridge and Valley Pitch Pine Peat Woodlands, and over half of its Red Maple-Black Gum Peatmoss Swamps and Tussock Sedge Wet Meadows are found in this CFA. These plant communities are vulnerable to disturbance and the spread of non-native invasive plants. Disturbance should be avoided, and non-native invasive plant infestations should be treated.

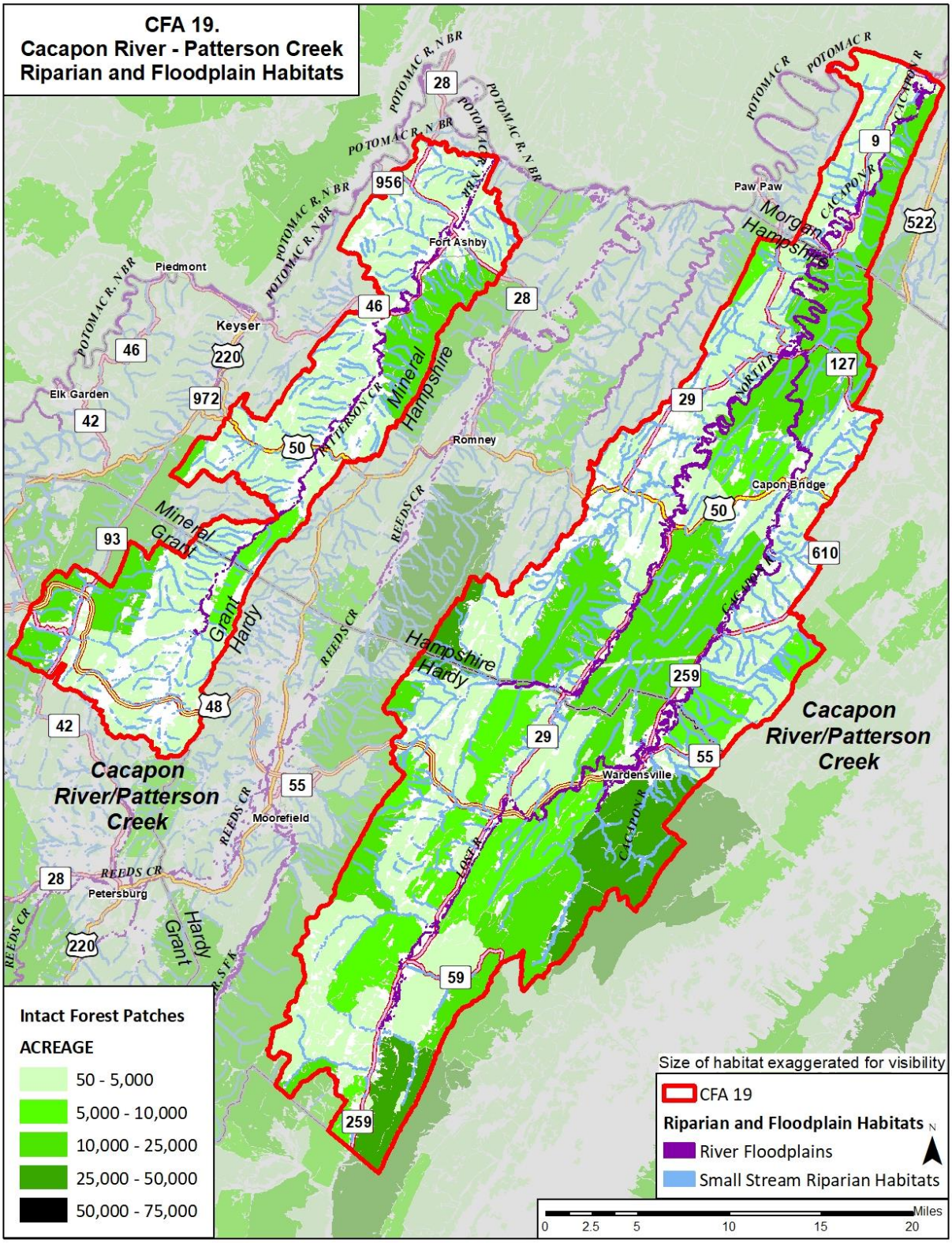
Rare Plant Communities in Aquatic, Floodplain and Riparian Habitats.

HABITAT	COMMON NAME	G RANK	S RANK	RELATIVE ABUNDANCE
High Allegheny Wetlands	Red Maple - Black Gum / Peatmoss Swamp	GNR	S2	53%
High Allegheny Wetlands	Tussock Sedge Wet Meadow	G4G5	S3	34%
High Allegheny Wetlands	Threeway Sedge Fen	GNR	S1	25%
High Allegheny Wetlands	American Bur-Reed Marsh	G3?	S2	5%
High Allegheny Wetlands	Red Maple - Black Gum / Peatmoss Swamp	GNR	S2	53%
High Allegheny Wetlands	Tussock Sedge Wet Meadow	G4G5	S3	34%
High Allegheny Wetlands	Threeway Sedge Fen	GNR	S1	25%

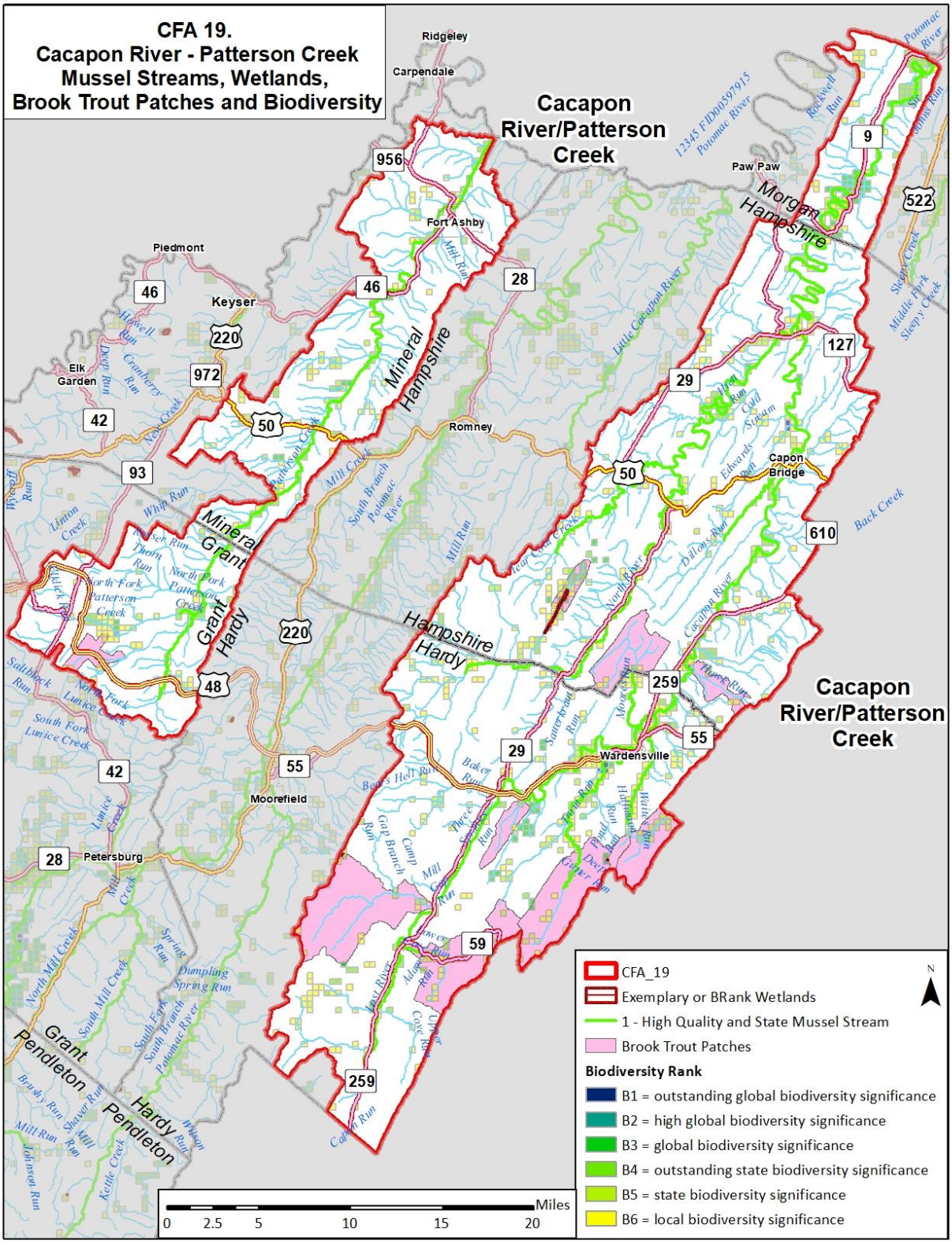
HABITAT	COMMON NAME	G RANK	S RANK	RELATIVE ABUNDANCE
High Allegheny Wetlands	American Bur-Reed Marsh	G3?	S2	5%
River Floodplains	Red Maple - Black Gum / Peatmoss Swamp	GNR	S2	53%
River Floodplains	Tussock Sedge Wet Meadow	G4G5	S3	34%
River Floodplains	Green Ash - Silver Maple Swamp	G4	S1	22%
River Floodplains	Mountain Valley Oak Swamp	G3G4	S1	18%
River Floodplains	Switchgrass - Big Bluestem Riverscour Prairie	G2G3	S2	10%
River Floodplains	American Bur-Reed Marsh	G3?	S2	5%
Sinkhole and Depression Ponds	Sinkhole Marsh	G1	S1	15%
Small Stream Riparian Habitats	Ridge and Valley Pitch Pine Peat Woodland	G1	S1	100%
Small Stream Riparian Habitats	Red Maple - Black Gum / Peatmoss Swamp	GNR	S2	53%
Small Stream Riparian Habitats	Tussock Sedge Wet Meadow	G4G5	S3	34%
Small Stream Riparian Habitats	Threeway Sedge Fen	GNR	S1	25%
Small Stream Riparian Habitats	Green Ash - Silver Maple Swamp	G4	S1	22%
Small Stream Riparian Habitats	Mountain Valley Oak Swamp	G3G4	S1	18%
Small Stream Riparian Habitats	American Bur-Reed Marsh	G3?	S2	5%
Small Stream Riparian Habitats	Red Maple - White Oak Forest Seep	G2	S2	4%

Maps illustrating riparian and floodplain habitats, mussel streams (mapped by WVDNR in 2018), exemplary wetlands (as assembled by WVDNR in 2015), brook trout habitat patches (provided by the Eastern Brook Trout Joint Venture based on an assessment in 2015) and biodiversity are on the following pages. These areas provide core habitat and movement corridors for many of the priority species and rare plant communities listed above and are priority habitats. Patterson Creek, the Cacapon, North and Lost Rivers, Dillons Run, Trout Run, Waites Run and Tear Coat Creek are designated state mussel streams. These streams and several others support large clusters of biodiversity occurrences, and along with brook trout patches, require careful management to maintain those priority species. There is a large exemplary wetland complex in Short Mountain WMA that is home to SGCN and rare communities. In addition to providing important habitat for priority species, floodplain habitats along the larger rivers and numerous small stream riparian corridors are critical for maintaining the form and function of streams and rivers. Floodplain and riparian habitats and brook trout habitat patches outside of the larger forest patches may be more vulnerable to stresses.

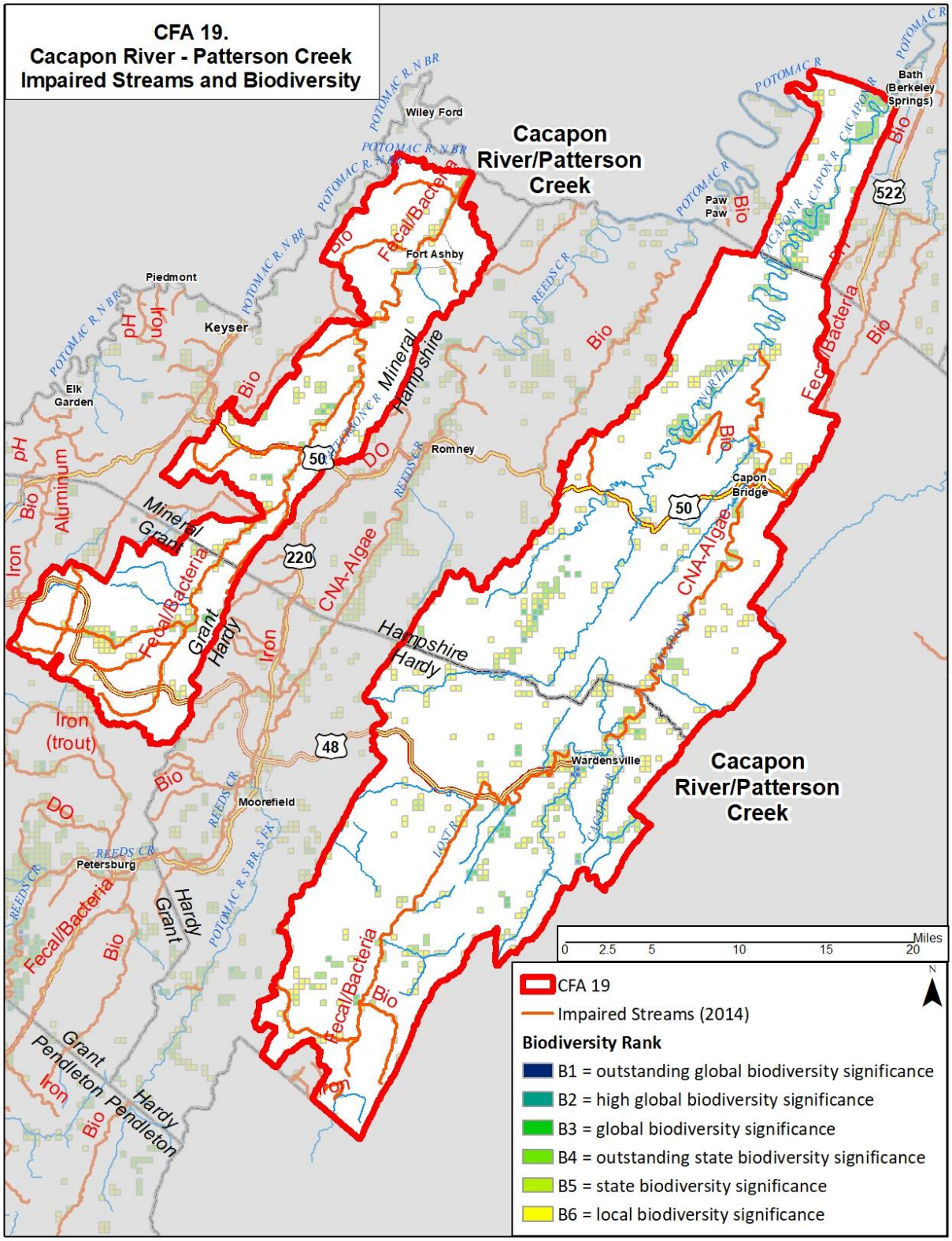
Riparian and Floodplain Habitats



Mussel Streams, Wetlands, Brook Trout Habitat Patches



Impaired Streams and Biodiversity



Habitat Stresses and Conservation Actions

Direct stresses to priority species include cattle trampling mussels and the over-fishing of eels and elvers. Common shiners may suffer from translocation and hybridization. Wood turtles and Spotted turtles suffer from the direct impacts of illegal collection and poaching. The table below lists habitat stresses on priority species, and conservation actions to alleviate those stresses. For example, protecting and restoring streamside riparian buffers is an important conservation action that improves water quality as well as both in-stream and riparian habitat for priority bird, fish, mussel, dragonfly/damselfly, and plant species. A map showing the biological and fecal/bacterial stream impairments on Patterson Creek and Lost River, and Algae impairment on the Cacapon (compiled by WVDEP in 2014) is on the previous page. These impaired streams are also home to clusters of SGCN and biological diversity. Improving water quality in these impaired streams is an important conservation action, especially where priority SGCN are present.

Habitat Stresses and Conservation Actions in Aquatic, Floodplain and Riparian Habitat

Habitat Stress	**Conservation Action**
Loss of floodplain, wetland, and riparian habitat	Habitat protection and monitoring through land use planning, conservation easements and other programs and activities
Loss of instream habitat	In-stream and riparian habitat restoration
Water quality- wastewater, stormwater, and effluents	Treatment, regulation and management of wastewater, stormwater, and effluents
Aquatic passage barriers	Remove or modify barriers
Water quality- loss of riparian vegetation, sedimentation	Stream buffer planting and fencing, landowner outreach
Cattle access into mussel streams	Stream buffer planting and fencing, landowner outreach
Increasing ice and water scour of streambanks and floodplains	Stream and buffer restoration/protection, consultation with experts, reduce flash flood impacts, monitoring
Hemlock wooly adelgid -hemlock mortality and loss of shade along headwater streams	Treat and underplant remaining riparian hemlock stands along headwater streams
Acid deposition in headwater streams	Improve pH in headwater streams
Invasive plants; Land use change and water quality; Climate change	Targeted treatment of cattail and other invasive plants; improve water quality

Climate Change and Habitat Resilience

As noted in the Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et. al, 2015), riparian forests are vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation. Impervious cover may exacerbate these impacts. Drought may stress plants and increase their susceptibility to wildfire, forest pests and pathogens. Warming temperatures and increased disturbances may enable non-native invasive plant species to outcompete native species. Although riparian forests are adapted to some level of disturbance and variable conditions, habitat alterations in agricultural and developed areas, habitat fragmentation and invasive species may limit the ability of riparian forests to adapt to climate change.

The Assessment also describes how instream habitats and associated plant and animal species may be stressed by climate change-related increases in temperature, droughts, flood frequency and severity, and resulting erosion and sedimentation. Low flow events may also become more frequent and severe. Warming surface waters is likely to result in water quality degradation and eutrophication. Many aquatic species and life stages are adapted to specific timing and ranges of flow and temperature, as well as water quality variables. Climate change may impact different species and life stages in different ways. Cold water habitats and aquatic communities may be at particular risk. Areas within a watershed may be sensitive to increases in air temperature, depending on local factors such as watershed characteristics, position within the watershed, upstream land uses, groundwater contributions, forest cover and shading.

Restoring and maintaining the health, size, and connectivity of native riparian forests along streams and rivers can provide riparian habitat, shade and cooling, organic matter, structure and debris, protect stream banks and in-stream habitat during high flows, and maintain water quality. Stabilizing eroding stream banks using natural channel design techniques, and reconnecting streams with their floodplains can restore fluvial processes and floodplain habitats. Cleaning and enlarging culverts and stream crossings to accommodate increased peak flows and aquatic organism passage can reduce flood damage to infrastructure and habitat and allow aquatic organisms to reach additional habitat as they adapt to changing conditions.

Below is a summary of climate stresses on aquatic, floodplain and riparian habitat, and actions to boost their resilience (Swanston et. al, 2016). While climate stresses are listed separately, aquatic, floodplain and riparian habitats are often impacted by multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Many of these actions reiterate previously listed conservation actions to reduce stress on priority species and could have positive outcomes for priority species as well as habitat resilience. WVDNR, land managers, landowners and partners may select the actions best suited to their specific site conditions, management goals and objectives, from the list below or other sources.

Climate Stresses and Resilience Actions in Aquatic, Floodplain and Riparian Habitat

Climate Stresses	**Habitat Resilience Actions**
• Increased flood frequency and severity, erosion, and sedimentation • Increased surface water temperatures, low-flow events, and water quality degradation • Increased risk of drought and wildfire • Increased competition from non-native invasive species, pests, and pathogens	• Restore and maintain the health, diversity, and connectivity of riparian forests • Stabilize eroding streambanks and reconnect stream hydrology to floodplains • Clean and enlarge culverts and stream crossings to accommodate peak flows and aquatic organism passage • Minimize disturbance to riparian forests, promptly revegetate after disturbance, prevent the introduction and establishment of invasive plant species, and remove existing invasive species • Protect refugia for cold water habitat

Implementation Plan

WVDNR will work with interested partners and landowners to plan, implement, and measure the effectiveness of conservation actions to benefit priority species in aquatic, floodplain, and riparian habitats.

Implementation Plan for Aquatic, Floodplain and Riparian Habitats

Action	Partners /Programs	Effectiveness Measures
Riparian Corridor Habitat Protection: • Conservation Easements	• County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust • USDA Natural Resource Conservation Service ACEP	• Acres of aquatic and riparian habitat protected for priority species • Abundance & distribution of priority species and habitats
Riparian Corridor Habitat Protection: • Land Use Planning	• County Planning Commissions	• Acres of habitat protected through land use planning, floodplain, and stormwater regulations
Riparian Corridor Habitat Protection • Incentive Programs	• USDA Farm Service Agency CRP and CREP	• Acres of aquatic and riparian habitat protected for priority species • Abundance & distribution of priority species and habitats
In-stream and riparian habitat restoration, streambank stabilization and floodplain re-connection	• USDA NRCS EQIP • USDA FSA CREP • WVDEP & WVCA • Trout Unlimited • USFWS Partners for Fish and Wildlife • Public Land Managers	• Acres or linear feet of in-stream and riparian habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Planting and fencing stream buffer zones	• USDA NRCS EQIP • USDA FSA CREP • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOF • WVDEP and WVCA	• Acres or linear feet of stream buffer zones planted and fenced to protect priority species • Before and after comparison: abundance & distribution of priority species

Action	Partners /Programs	Effectiveness Measures
Improved wastewater and stormwater treatment	• WVDEP • WVDHHR • County governments	• # wastewater and stormwater systems installed or improved • Change in fecal, sediment and other water quality measurements • Before and after comparison: abundance & distribution of priority species
Clean, enlarge or remove culverts and stream crossings for higher peak flow and aquatic organism passage	• Trout Unlimited • USFWS Partners for Fish and Wildlife • Public Land Managers	• # barriers re-designed or removed • # miles stream opened • Before and after comparison: abundance & distribution of priority species
Reduce flood impacts see also: • Remove or re-design barriers • Planting and fencing stream buffer zones • Restoration of in-stream and riparian habitat	• County Planning Departments	
Treat and underplant remaining riparian hemlock stands along headwater streams	• Trout Unlimited • USFWS Partners for Fish and Wildlife • U.S. Forest Service • WVDNR	• Acres or linear feet of riparian area treated • Treatment and planting success rate
Improve water quality in streams and wetlands	• WVDEP and WVCA • NRCS EQIP & CSP • FSA CRP & CREP	• Change in water quality measurements • Before and after comparison: abundance & distribution of priority species
Improve pH in headwater streams	• WVDEP • WVDNR	• Change in water quality measurements • Before and after comparison: abundance & distribution of priority species

Action	Partners /Programs	Effectiveness Measures
Treat cattail and other invasive plants in wetlands	• NRCS EQIP • FSA CRP and CREP • USFWS Partners for Fish and Wildlife	• Acres of wetland treated • Treatment success rate • Before and after comparison: abundance & distribution of priority species
Landowner outreach and habitat protection demonstration projects	• Cacapon and Lost Rivers Land Trust • Trout Unlimited • Friends of Cacapon	• # landowners reached • resulting # practices or acres enhanced

Human Benefits

Actions to restore and protect aquatic, floodplain and riparian habitat may have numerous health and economic benefits for local residents and communities, including absorption and reduction of pollution in water ways and drinking water sources, absorption and reduction of flood waters and reduced flood damages, soil conservation and improved agricultural productivity, and improved hunting, fishing and recreational opportunities.

Subterranean Habitats

Karst and Cave Habitats

Areas with karst geology and subterranean caves provide unique habitats that may be influenced by human activities, surface land use, and surface and underground hydrology in the surrounding landscape. Caves provide important habitat for bats that move in and out, as well as a diverse group of vertebrate and invertebrate animals that have evolved specialized adaptations to permanent underground living. Common traits exhibited by permanent cave dwellers (troglobites) include blindness (or complete loss of eyes) and reduced pigmentation. On the following pages, one map illustrates areas with karst geology running north to south in the central part of the CFA. Karst areas in smaller and more fragmented forest patches may be more vulnerable to stresses. The map on the subsequent page illustrates karst feature density with 3-kilometer buffers offset randomly, and one biologically significant cave near Wardensville with a 3-mile random offset buffer. This data was provided by the West Virginia Speleological Society, with offset buffers developed by WVDNR. Caves classified by WVDNR as biologically significant may host rare bat or endemic cave species, or exceptional biological diversity. These areas require careful management to minimize disturbance on karst and cave habitats and protect priority species.

Priority Species

Caves in this CFA provide core habitat for the following priority species, all of which are rare and dependent on specific cave habitats for their survival. Of special significance, this CFA hosts 67% of the state's Allegheny Cave Amphipod, and 50% of the state's Morrison's Cave Amphipod.

Priority Species in Karst and Cave Habitats

TAXA	SCIENTIFIC NAME	COMMON NAME
Cave Invertebrates	Stygobromus franzi	Franz's Cave Amphipod
Cave Invertebrates	Stygobromus allegheniensis	Allegheny Cave Amphipod
Cave Invertebrates	Stygobromus morrisoni	Morrison's Cave Amphipod
Cave Invertebrates	Onychiurus janus	A Cave Springtail
Cave Invertebrates	Zygonopus krekeleri	West Virginia Blind Cave Millipede

Habitat Stresses and Conservation Actions

Caves and subterranean habitats, particularly in porous karst geology, are closely tied to and impacted by changes to water quality and land use in adjacent areas. The following table lists stresses affecting wildlife in caves and subterranean habitats, and conservation actions landowners and partners can take to address them. In addition, WVDNR is developing cave management plans for all biologically significant caves. The management plans will describe cave ownership, access, bats and other SGCN present, threats, surrounding areas requiring careful management, recommended access restrictions and conservation actions.

Habitat Stresses and Conservation Actions for Karst and Cave Habitats

Habitat Stress	Conservation Action
Water quality	Education, wastewater treatment, fencing, riparian plantings
Land use changes	Land protection, land use planning and careful management around caves

Climate Change and Habitat Resilience

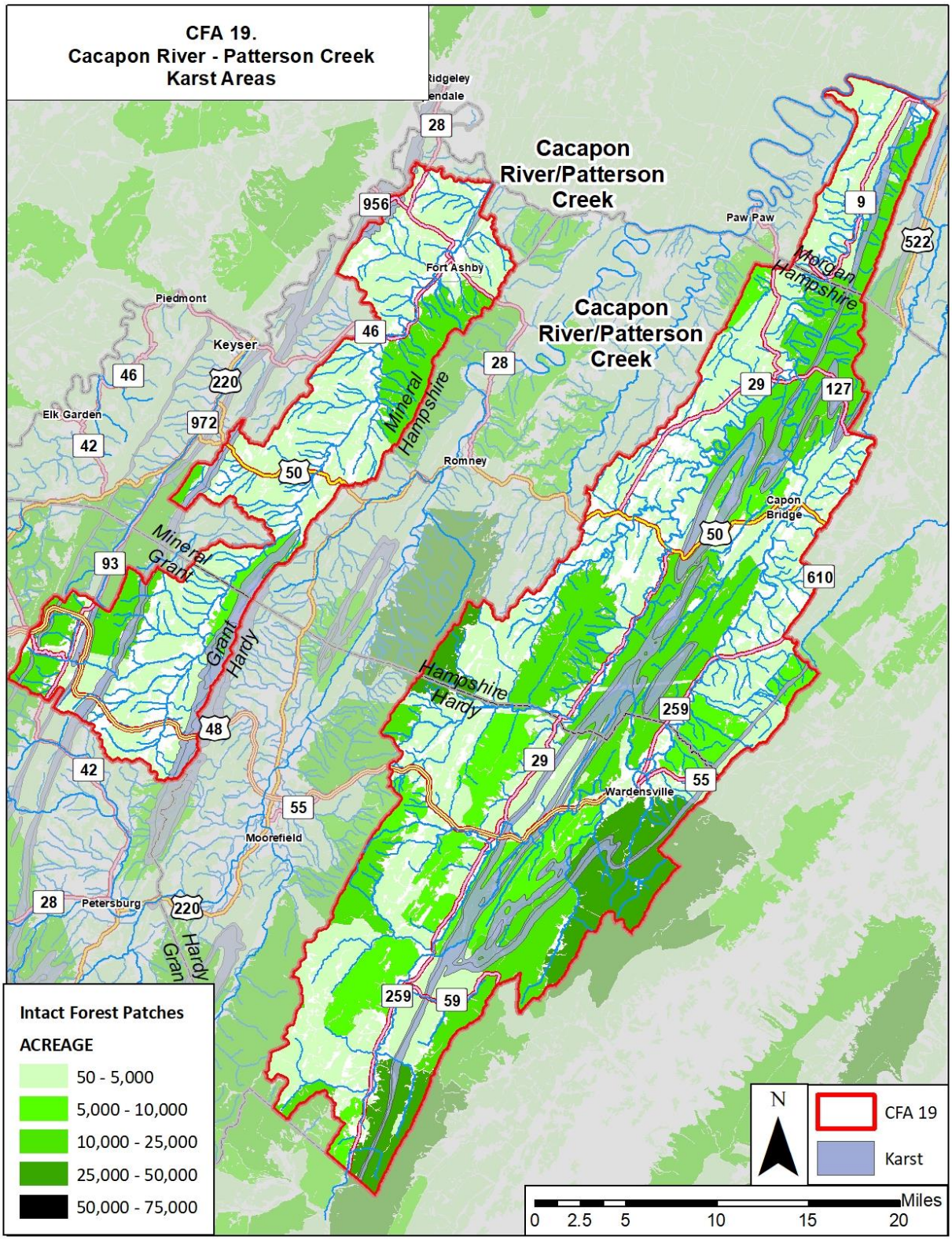
The Central Appalachians Forest Ecosystem Vulnerability Assessment (Butler et. al, 2015), noted that ecosystems that are limited by geological or hydrological features, such as cave and karst habitats, may be restricted from shifting across the landscape in response to climate change. However, cave and karst habitats that are connected more closely with groundwater inputs than surface water may be buffered by the impacts of climate change, and subterranean habitats may be buffered from increasing surface temperatures. But caves and karst areas may be vulnerable to groundwater extraction during droughts as well as changes in surface water flow regimes, nutrient inputs, high flows, and contaminants carried by floods, which may be exacerbated by impervious cover within the watershed (Swanston et. al, 2016). Restoring and maintaining riparian corridors, water quality and natural flow regimes, and limiting impervious cover in areas upstream and above caves and karst may boost the resilience of cave ecosystems. Some cave dwelling species also rely on adjacent forest, riparian and aquatic habitats. Maintaining the resilience of adjacent ecosystems could further buffer cave species from the impacts of climate change.

Below is a summary of climate stresses on cave and karst habitats, and actions to boost their resilience. Although climate stresses are listed separately, subterranean habitats are often impacted by a multiple climate stresses occurring simultaneously and actions to boost habitat resilience are intended to address multiple climate stresses. Some of these actions repeat previously listed conservation actions to reduce stress on priority species and could benefit priority species while also boosting habitat resilience. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

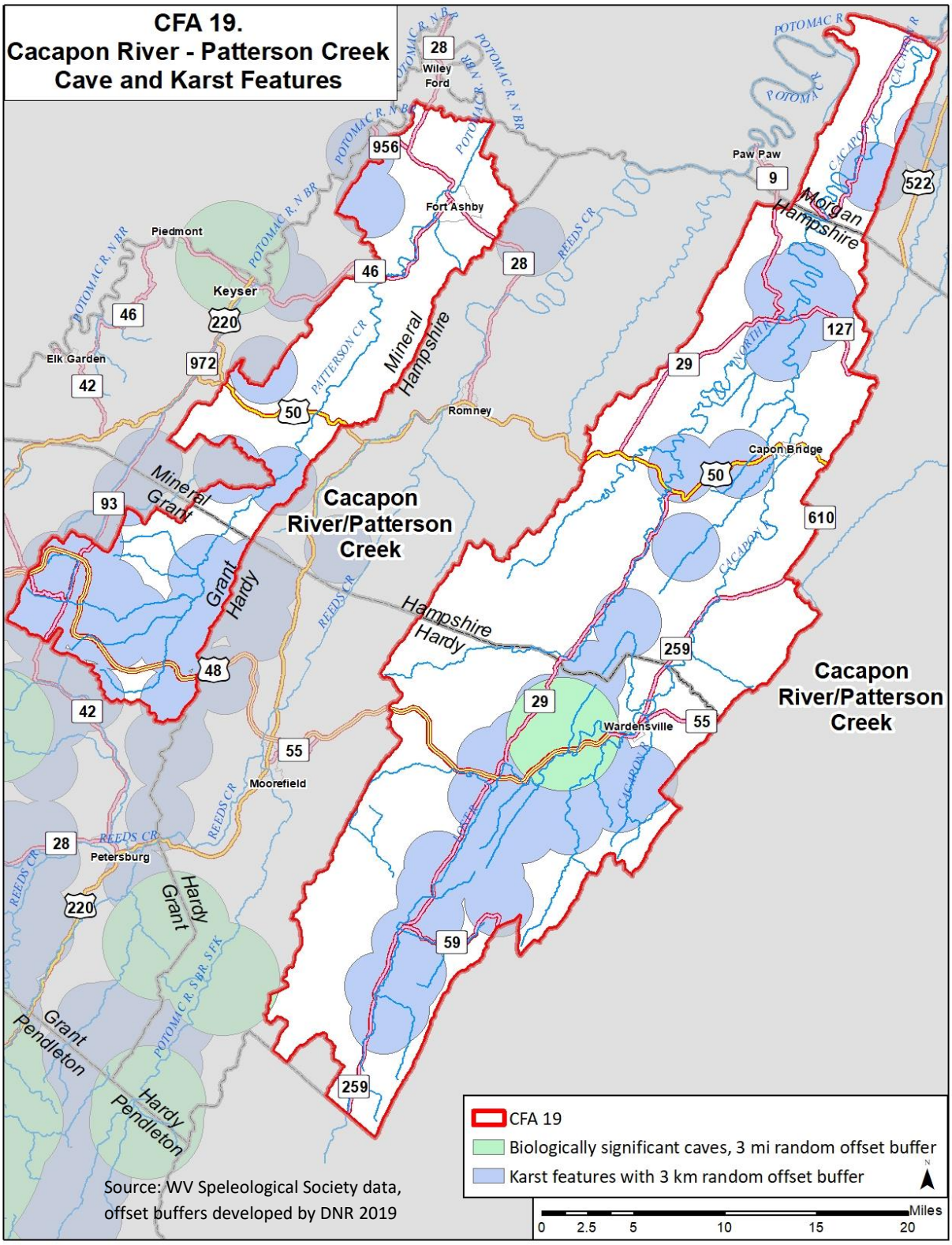
Climate Stresses and Resilience Actions in Karst and Cave Habitats

Climate Stress:	Habitat Resilience Action:
• Increased flood frequency and severity, nutrient inputs and contaminants • Increased surface water temperatures, low-flow events, and ground water withdrawals • Impacts to adjacent forest, riparian and aquatic habitat	• Restore and protect surface water quality and hydrology • Limit impervious cover • Maintain ground water quality and quantity • Maintain resilient forests, riparian and aquatic habitat around karst and cave ecosystems

Karst Areas


CFA 19.
Cacapon River - Patterson Creek
Karst Areas
Cacapon River/Patterson Creek
Cacapon River/Patterson Creek
Ridgeley
Wendale
Fort Ashby
Piedmont
Keyser
Elk Garden
Romney
Paw Paw
Capon Bridge
Wardensville
Moorefield
Petersburg
Mineral
Hampshire
Grant
Hardy
Morgan
28
956
46
220
972
42
50
93
48
55
29
127
522
9
610
259
59
Intact Forest Patches
ACREAGE
50 - 5,000
5,000 - 10,000
10,000 - 25,000
25,000 - 50,000
50,000 - 75,000
N
CFA 19
Karst
Miles
0 2.5 5 10 15 20

Karst and Cave Features



Implementation Plan

WVDNR will work with landowners and the following partners and programs to implement and measure the impact of conservation actions around caves and karst habitat.

Implementation Plan for Caves and Karst Habitats

Action	Partners /Programs	Effectiveness Measures
Land protection around caves and karst habitat: • Conservation Easements	• County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust • The Nature Conservancy • USDA Natural Resource Conservation Service ACEP	• Acres of habitat protected around caves and karst habitat • Abundance & distribution of priority species and habitats
Land protection around caves and karst habitat • Incentive Programs	• USDA Farm Service Agency CRP and CREP	• Acres of habitat protected • Abundance & distribution of priority species and habitats
Land use planning around caves and karst habitat	• County Planning Commissions	• Acres of cave, karst and buffer habitat protected for public health and safety through land use planning ordinances
Stream buffer fencing and riparian plantings around caves and karst	• USDA NRCS EQIP • USDA FSA CREP • Trout Unlimited • USFWS Partners for Fish and Wildlife • WVDOF • WVDEP and WVCA	• Acres or linear feet of stream buffer zones planted and fenced • Before and after comparison: abundance & distribution of priority species
Sinkhole Cleanups, cave research and mapping, protection and landowner outreach	• WVACS • WVCC • CCV	• # of cave/karst resources protected or restored • # landowners participating in cave/karst protection and restoration activities
Land management around caves and karst	• USDA NRCS EQIP • USDA FSA CREP • Trout Unlimited • USFWS Partners for Fish and Wildlife • GWNF • WVDNR	• Acres of habitat managed • Before and after comparison: abundance & distribution of priority species

Action	Partners /Programs	Effectiveness Measures
Improved wastewater treatment around caves and karst habitat	• WVDEP • WVDHHR	• # systems installed or improved • Change in fecal and other water quality measurements • Before and after comparison: abundance & distribution of priority species

Human Benefits

Actions to restore and protect subterranean habitat may benefit human health and economies in surrounding communities, mainly through the protection of water quality and drinking water sources.

Agricultural and Developed Habitats

Many species of wildlife rely on agricultural lands, especially pastures and woody vegetation in fallow areas, abandoned fields, field borders, wetlands and riparian corridors. Some species even rely on habitat in more developed lands in residential and urban areas. Most agricultural lands and developed areas are in valley bottoms and floodplains. A map on the following page shows the location of agricultural and developed habitats and illustrates that they are associated with many examples of biodiversity. Maintaining pastures, fallow fields, woody vegetation, wetlands and riparian corridors is a priority for SGCN associated with these agricultural habitats.

Priority Species

Agricultural lands including cultivated crops, pastures, and hayfields, along with adjacent areas of natural vegetation in and around adjacent forests and woodlots, hedgerows, fallow areas, ponds, wetlands, streams, and riparian areas provide valuable habitat for several priority grassland bird species in the CFA. The following is a list of priority SGCN in the CFA associated with agricultural habitats. Developed areas also provide important habitat, most notably for the Chimney Swift.

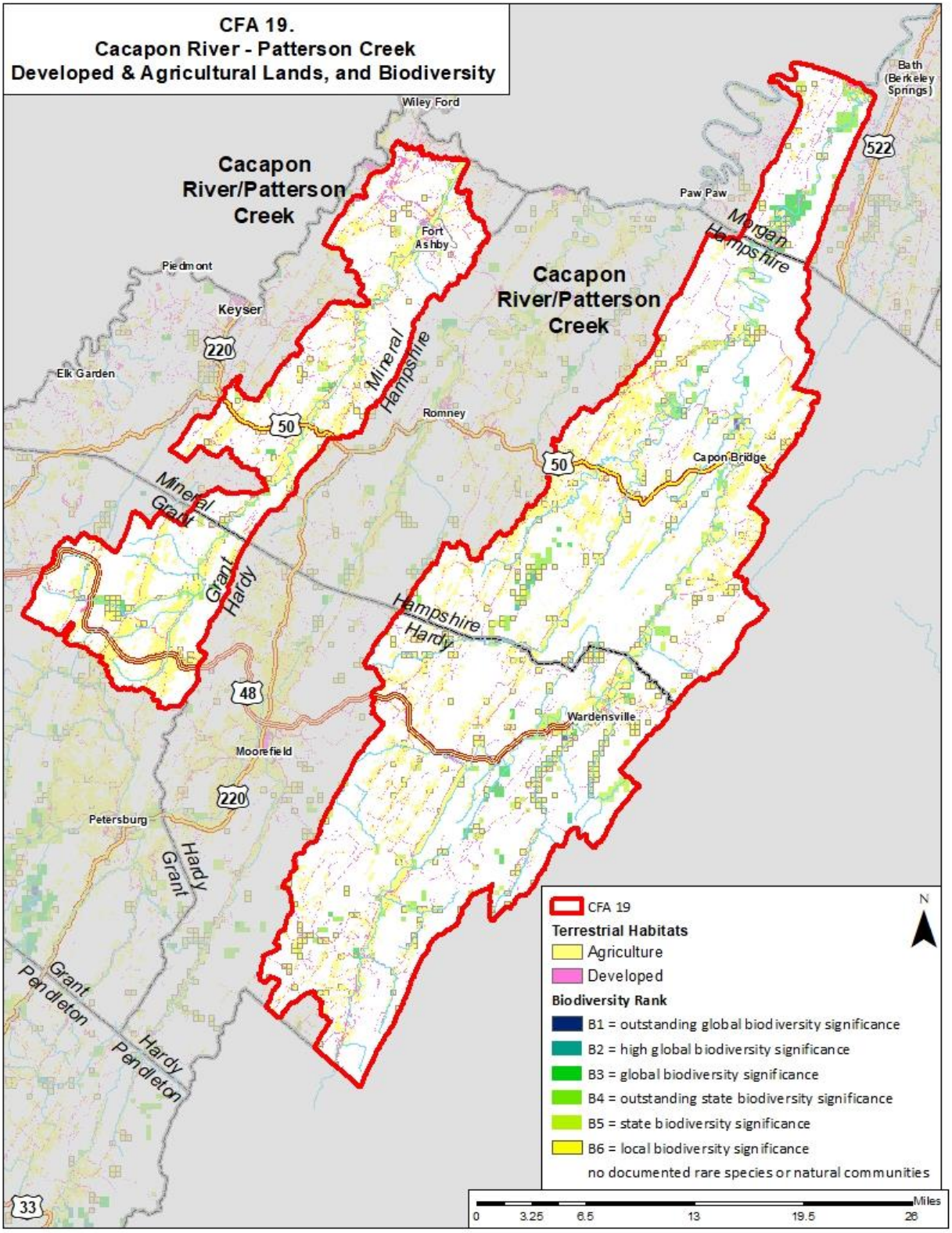
Priority Species in Agricultural and Developed Habitats

TAXA	SCIENTIFIC NAME	COMMON NAME
Birds	Chaetura pelagica	Chimney Swift
Birds	Tyto alba	Barn Owl
Birds	Falco sparverius	American Kestrel
Birds	Colinus virginianus	Northern Bobwhite
Birds	Scolopax minor	American Woodcock
Birds	Lanius ludovicianus migrans	Migrant Loggerhead Shrike
Birds	Icteria virens	Yellow-breasted Chat
Birds	Spizella pusilla	Field Sparrow
Birds	Pooecetes gramineus	Vesper Sparrow
Birds	Ammodramus savannarum	Grasshopper Sparrow
Birds	Dolichonyx oryzivorus	Bobolink
Birds	Sturnella magna	Eastern Meadowlark

Habitat Stresses and Conservation Actions

The conversion of farmland for residential and commercial development reduces valuable habitat for wildlife, especially grassland birds. In addition, modern farming practices have resulted in the intensification of mechanized farming practices and the expansion of areas cleared for agriculture. Consequently, much natural vegetation providing wildlife habitat in grasslands, wetlands, fallow areas, riparian corridors, hedgerows, and forest edges has been cleared. The timing of agricultural practices also impacts some priority species. For example, early haying impacts ground nesting birds. Many SGCN also rely on habitat created by utility corridors, where the cutting of vegetation or herbicide treatment can have direct impacts on native birds and their nests. Rodenticides may also harm Barn Owls and other birds of prey.

Developed and Agricultural Lands, and Biodiversity



The table below lists the habitat stresses to priority species in agricultural and developed areas, and conservation actions to address them.

Habitat Stresses and Actions in Agricultural and Developed Habitats

Habitat Stress	Conservation Action
Residential development	Land use planning, land protection, conservation easements
Insufficient nest microhabitat	Nest box installation and monitoring
Insufficient habitat, cover and predation	Reduce clean farming practices, maintain early successional forest
Barn owl poisoning from rodenticides	Outreach to landowners to reduce rodenticides
Clean farming practices: loss of woody veg.	Retain or plant shrubs, hedgerows, and hawthorns
Clean farming practices: grassland conversion	Prevent conversion of grasslands to croplands
Grassland bird nest loss from early haying	Delay hay harvest
Herbicide/veg. management in utility corridors	Manage utility corridors for wildlife habitat
Chimney capping, loss of older structures	Landowner outreach, uncap chimneys, install towers for chimney swifts

Climate Change and Habitat Resilience

According to Adaptation Resources for Agriculture (Janowiak et. al, 2016), agriculture will likely be impacted by many of the same climate changes that affect forest and freshwater habitats. Likely changes include increasing temperatures, longer growing seasons, increasing number of hot days and nights, and changing precipitation patterns. Impacts include increases in the risk of damage to soil, crops, and infrastructure from extreme storm and precipitation events, flood damage, soil moisture stress and drought, competition from weeds and invasive plants, crop damage from insects and pathogens, and livestock parasites and pathogens. Butler et. al (2015) also noted that impervious surfaces in developed areas can exacerbate many of these impacts.

Many wildlife species associated with agricultural and developed lands rely on grassland and pasture, fallow fields, floodplain and riparian corridors, streams and wetlands, and areas of natural vegetation around field and forest edges. In agricultural settings, these areas may already be degraded and sensitive to disturbance. As we have seen in previous sections of this plan, these areas may also be susceptible to impacts from climate change. Riparian forests may be vulnerable to climate change stressors including increased flood frequency and severity and resulting erosion and sedimentation in streams. Drought may stress streams and aquatic life, as well as plants, and increase their susceptibility to pests and pathogens. Warming temperatures and increased storm disturbances may enable non-native invasive plant species to outcompete native species.

Janowiack et. al (2016) list numerous strategies to boost the resilience of agriculture to climate change, including maintaining soil health and water quality, reducing competition from weeds and invasive species, creating pollinator habitat, adapting farm infrastructure such as stream crossings to higher peak

flows, adapting farm practices or shifting agricultural land use to match changing conditions. Managing farms as part of a larger landscape by maintaining, restoring and connecting natural habitats such as streams, wetlands, riparian areas and forest edges can boost the resilience of farms by buffering hydrological impacts while providing habitat and corridors wildlife to persist and adapt to climate change. In developed areas, limiting and buffering impervious surfaces, and using constructed wetlands and other green infrastructure can also reduce the hydrological impacts of climate change.

Below is a summary of climate stresses on wildlife habitat in agricultural and developed areas, and actions to boost their resilience. Climate stresses are listed separately, but agricultural habitats are often impacted by a multiple climate stresses occurring simultaneously. Therefore, actions to boost habitat resilience are intended to address multiple climate stresses. These actions reinforce conservation actions to reduce stress on priority species in agricultural and developed habitats. WVDNR, partners and landowners can collaborate to select the habitat resilience actions best suited to site conditions, conservation goals and land management objectives.

Climate Stresses and Resilience Actions for Agricultural and Developed Habitats

Climate Stress:	**Habitat Resilience Action:**
• Increased flood frequency and severity, erosion, and sedimentation • Increased surface water temperatures, low-flow events, and water quality degradation • Increased risk of drought and wildfire • Increased competition from non-native invasive species, pests, and pathogens	• Maintain soil health and water quality • Reduce competition from weeds and invasive species • Create pollinator habitat • Maintain, restore, and connect aquatic, riparian and forest habitats to buffer against hydrological impacts • Adapt farm practices, infrastructure and land uses to changing conditions • Reduce and buffer impervious surfaces, and use green infrastructure to absorb runoff and mitigate hydrological impacts

Implementation Plan

WVDNR will seek to engage the following partners and programs in implementing and measuring the effectiveness of conservation actions in agricultural habitats.

Implementation Plan for Agricultural and Developed Habitats.

Action	Partners /Programs	Effectiveness Measures
Habitat Protection: • Conservation Easements	• County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust • NRCS ACEP	• Acres of habitat protected for priority species • Abundance & distribution of priority species and habitats
Habitat Protection: • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning in agricultural areas
Habitat Protection • Incentive Programs	• FSA CRP and CREP	• Acres of habitat protected for priority species • Abundance & distribution of priority species and habitats
Reduce clearing of native vegetation; Retain or plant hedgerows and areas with native plants	• FSA CRP and CREP • NRCS EQIP and CSP • Public Land Managers	• Acres or linear feet of native vegetation planted and protected • Change in abundance, diversity and distribution of priority species and habitats
Maintain or restore aquatic, riparian and forest habitat as well as species and structural diversity in natural areas in and around farmland, and enhance connections between them	• FSA CRP and CREP • NRCS EQIP and CSP • Public Land Managers	• Acres of habitat restored for priority species • Abundance & distribution of priority species and habitats
Create early successional habitat	• NRCS EQIP • Public Land Managers	• Acres of habitat created • Change in abundance, diversity and distribution of priority species and habitats
Prevent conversion of grasslands to croplands	• FSA CRP and CREP	• Acres of grasslands planted and protected • Change in abundance, diversity and distribution of priority species and habitats

Action	Partners /Programs	Effectiveness Measures
Delay hay harvest	• FSA CRP	• Acres of hay fields under delayed harvest management • Change in abundance, diversity and distribution of priority species and habitats
Manage utility corridors to reduce wildlife impacts (implement BMPs promoted by the Wildlife Habitat Council, NRCS and other organizations)	• Landowners • Public Land Managers • Partners • Utility companies	• Acres of habitat restored for priority species • Before and after comparison: abundance & distribution of priority species
Landowner outreach and habitat protection demonstration projects	• Cacapon and Lost Rivers Land Trust • Friends of Cacapon • Public Land Managers	• # landowners reached • resulting # practices or acres enhanced
Nest box installation and monitoring for barn owls and American Kestrels	• Landowners and volunteer groups	• # next boxes installed • Change in abundance, diversity, and distribution of priority species
Outreach to landowners to reduce rodenticides for barn owls	• Landowners and volunteer groups	• # of landowners engaged • Reduction in use of rodenticides • Change in abundance, diversity, and distribution of priority species
Landowner outreach, uncapping chimneys, install towers for chimney swifts	• Landowners and volunteer groups	• # chimneys uncapped • # swift towers installed • Change in abundance, diversity, and distribution of chimney swifts
Adapt farm practices, infrastructure and land uses to changing conditions	• FSA CRP and CREP • NRCS EQIP and CSP • Landowners • Public Land Managers	• # practices or acres adapted • Change in abundance, diversity, and distribution of priority species

Human Benefits

Actions to restore and protect wildlife habitat within agricultural areas and developed lands may improve the resilience of these areas to the impacts of climate change, reduce associated damages, and provide benefits for human health and economies in surrounding communities. Benefits may include erosion control and improved water quality, improved hunting, fishing and recreational opportunities, and conservation of native pollinators for crop production.

Landscape Resilience and Connectivity

For the Cacapon River and Patterson Creek CFA, the SWAP included the following conservation action:

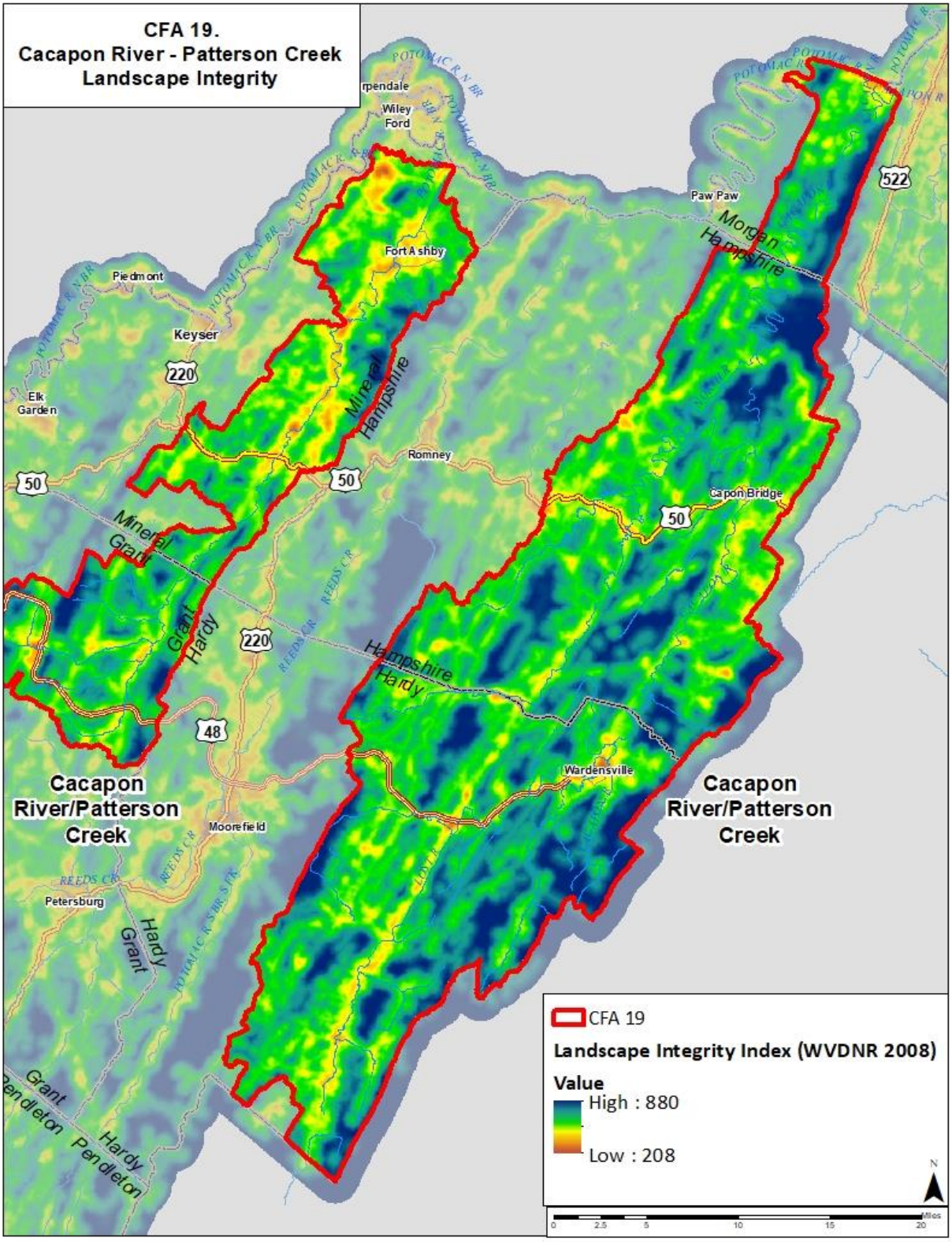
- Implement a comprehensive plan to enhance climate change resiliency through reducing other stressors, identifying, maintaining, and creating key habitat cores and corridors, and protecting areas of high landscape complexity and integrity".

The conservation and resilience actions described previously in this action plan aim to reduce stressors on priority species in each major habitat type and enhance the resilience of those habitats to climate change. Some of those actions include protecting refugia, core areas of intact habitats and habitat corridors. Habitat cores are patches of high-quality habitat for priority species, surrounded by areas with a different community structure, and serve as nodes in a connected ecological network (Harrison and Odell, 2016; USDA Natural Resources Conservation Service, 2004). Habitat cores identified for protection in this CFA include large forest blocks, wetlands, habitats limited to specific soil types and geology such as shale barrens, cliffs and talus, biologically significant caves and their buffer zones, and core aquatic habitat such as mussel streams and brook trout habitat patches. Important habitat corridors identified for protection include connected forest patches, intact river floodplains and small stream riparian forests. Protecting corridors of terrestrial and aquatic habitat connected to habitat patches and larger core areas may allow for species movement and enhance the flow of genetic material in response to climate change (Butler et. al, 2015; Anderson et. al, 2016a).

But wildlife conservation in changing climate may require conservation actions at a landscape level, across habitat types, and beyond individual habitat cores and corridors. Anderson (2016b) summarized a wealth of current research demonstrating how the increasing frequency and severity of storms, floods, droughts and fires may cause species to respond by shifting location or behavior within their existing habitat, evolving to adapt to new conditions, or shifting their distributions across the landscape. Evidence has been documented for over 1000 species currently shifting one of four ways: locally toward suitable microclimate, upslope to higher elevations, downslope towards moist riparian areas, and northward toward cooler latitudes. However, landscape fragmentation has been shown to slow movement in response to climate change. Enabling wildlife to shift and adapt to climate change will require the conservation of a network of unfragmented landscapes within which species can shift their range to more suitable local microclimates or upslope, downslope or northward.

In 2008 the WVDNR developed a model of landscape integrity to identify unfragmented landscapes. The map on the subsequent page illustrates areas of high landscape integrity in the CFA. Landscape integrity is estimated to increase with distance from roads, powerlines, development, and other features that fragment the landscape. These high integrity landscapes tend to correspond to larger forest patches and most lie within public lands including the George Washington National Forest along the east side of the CFA, as well as Lost River and Cacapon Resort State Parks, and Short Mountain WMA. There are also landscapes of high integrity in private ownership, notably south of Short Mountain WMA and along the Mineral – Hampshire county line east of Patterson Creek. These areas are important for species movement in response to climate change and are priorities for protection of wildlife habitat.

Landscape Integrity



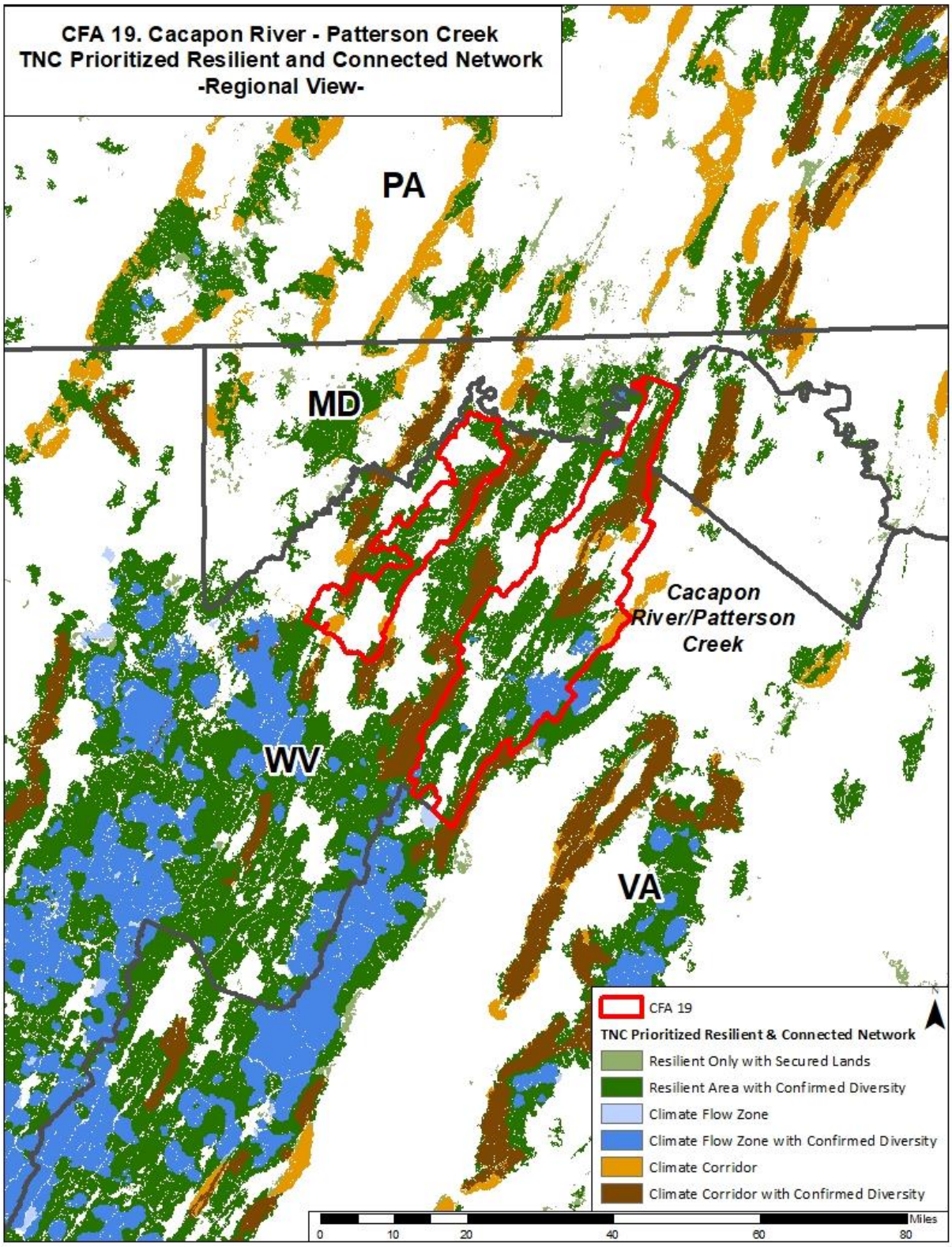
Building on the concept of landscape integrity, The Nature Conservancy (TNC) led a team of 60 scientists to identify areas representing all geophysical settings, with varied microclimates and natural cover, that were most likely to sustain native plants and animals and natural processes into the future and be resilient to climate change. The team identified resilient sites as those with topographic and elevation diversity that offer a range of habitat types and microclimates for species and ecosystems to adapt to climate change, along with high landscape integrity or local connectedness where species could move locally and disperse in response to climate change, and where natural processes like fire and floods could continue unimpeded. These are core areas for species movement and adaptation at a local level. They then modeled the movement or flow of species across the landscape over time in response to climate change, and as constrained by natural and human-caused barriers. This led to the identification of corridors of constrained movement, and flow zones of dispersed movement. These are corridors and core areas for species movement and adaptation at a landscape level. Lastly the team developed models that integrated landscape resilience, connectivity and the flow of species and populations across the landscape to develop a connected network of sites that represents the full suite of geophysical settings, includes known records of biological diversity, and has the configuration and connections necessary to support the continued movement of species in response to change conditions. To identify the subset of places most essential for sustaining biodiversity in a changing climate and aligned to the natural flow patterns across the region, the team then identified the most resilient and diverse lands representing all of the region's geophysical settings, recorded occurrences of biological diversity, resilient lands already secured through public ownership or conservation easements, and the riparian corridors and other landscape linkages with the most concentrated movement of species. This prioritized network covers 23% of the land in the Eastern United States.

This work is documented in Resilient Sites for Terrestrial Conservation in Eastern North America (Anderson et al, 2016a), and Resilient and Connected Landscapes for Terrestrial Conservation (Anderson et al, 2016b). The studies produced a series of maps (see http://maps.tnc.org/resilientland/) that identified the following areas:

- Resilient area: a place buffered from climate change because it contains diverse, complex, connected landscapes with many micro-climates that create options for species adapting to climate change.
- Climate corridor: a narrow conduit of natural cover in which the movement of plants and animals becomes concentrated, often along a stream corridor or ridgeline.
- Climate flow zone: areas with high levels of plant and animal movement that is less concentrated than in a corridor, such as an intact forest patches and areas of high integrity.

On the following page, the regional map of priority resilient and connected landscapes illustrates that the resilient, connected landscapes of the CFA form a critical bridge between the large forest blocks, resilient landscapes and flow zones to the south and the narrower climate corridors along the ridges and valleys stretching northeast into Pennsylvania. The resilient, connected landscapes in this CFA are critical to the species adapting to climate change within the larger network across the Eastern United States.

Prioritized Resilient and Connected Network: Regional View



On the next page is a more detailed view of the priority resilient, connected network of landscapes within the Cacapon River and Patterson Creek CFA, which includes many resilient lands, flow zones and corridors with confirmed biodiversity. On the eastern half of the Cacapon portion of the CFA there is a network of climate corridors, resilient areas and flow zones stretching from the state boundary on the Great North Mountain and Cove Mountain in the south, then north along the ridges on the east side of the North River, to the ridges around the Cacapon River. Other connected blocks of resilient land occur on the west side of the Cacapon watershed from Shenandoah and Branch Mountains in the south, up to around Spring Gap Mountain and Sideling Hill in the north. The Patterson Creek portion of the CFA also includes several blocks of resilient lands and connected landscapes, including the lands along Patterson Creek Mountain on the east, from Knobly Mountain in the Southwest north to Stagg Run, and the area toward the confluence of Patterson Creek and the North Branch at the Maryland State line. These priority resilient and connected landscapes contain the CFA's large forest patches and high integrity areas, and most of the CFA's rock outcrop, cliff and talus, and shale barren habitats, cave and karst features, and known biodiversity. Smaller patches of fragmented forest and agricultural areas are not included.

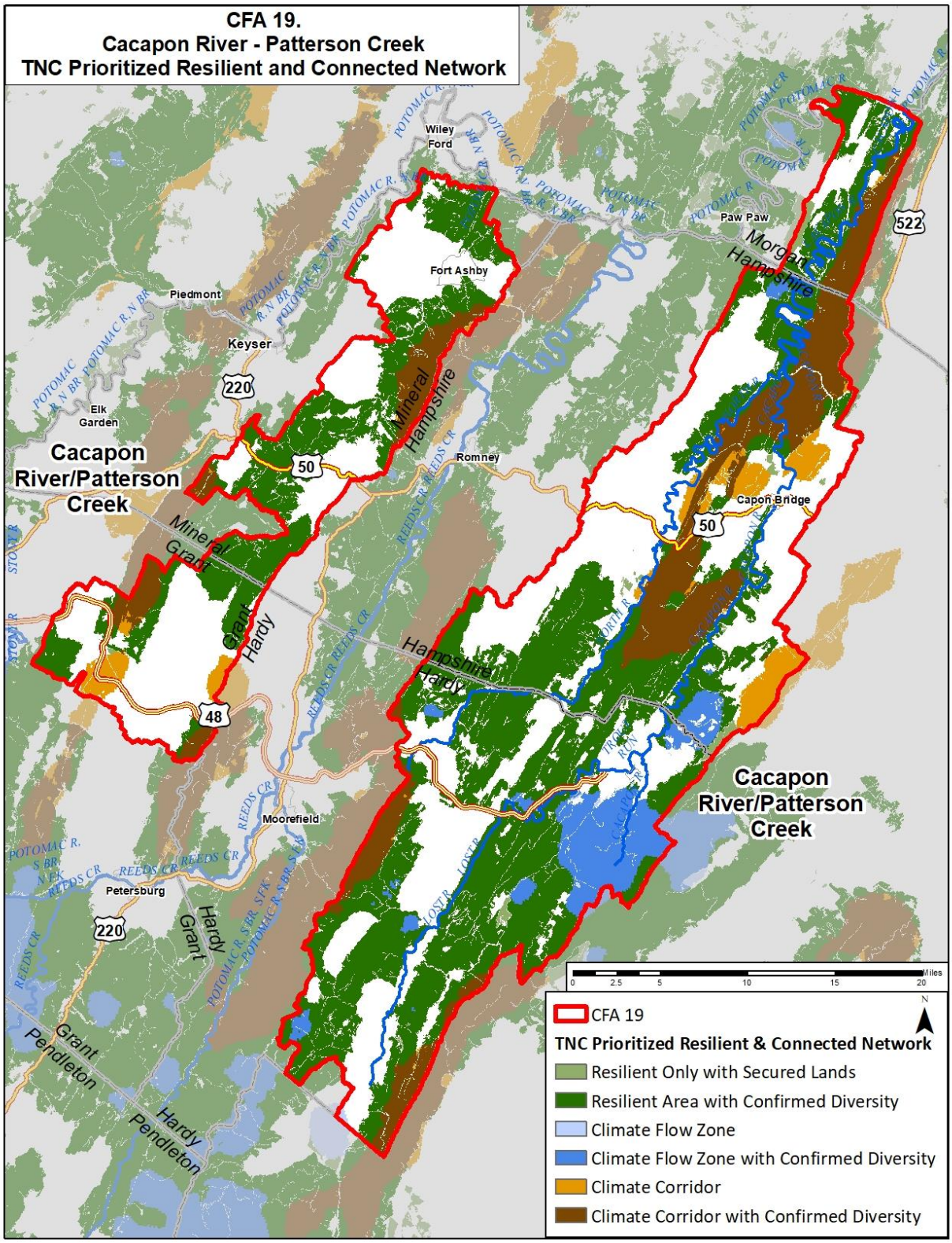
Protecting and maintaining these areas of high landscape integrity and the resilient areas, climate corridors and climate flow zones within the region's priority resilient and connected network is critical in order to enable priority SGCN and their habitat to adapt to climate change and persist in this CFA. These areas are priorities for conservation action within the CFA.

The table below summarizes conservation actions for climate resilience to address stresses from climate change at a landscape level.

Climate Stresses and Actions for Landscape Resilience and Connectivity

Climate Stress	**Conservation Action**
• Changing conditions exacerbating existing stresses on species and habitat • Species responding to climate change by shifting locally as well as across the landscape • Landscape fragmentation that prevents or constrains species movement	• Protect and maintain a connected network of resilient landscapes, flow zones and climate corridors across the landscape for species to adapt and shift locally and regionally in response to climate change

Prioritized Resilient & Connect Network: Detailed View



Implementation Plan

The resilient and connected landscapes in this CFA provide critical links to the larger network of resilient and connected landscapes in West Virginia, Maryland, Virginia, the Central Appalachians, and Eastern North America. They provide a blueprint of habitat cores and corridors where conservation actions to restore, maintain and protect natural habitat and remove barriers to movement will be crucial to enabling priority species and habitats to shift and adapt to climate change at both local and regional scales. The following implementation plan lists specific actions to protect, maintain and restore the network of resilient, connected lands within the CFA.

Implementation Plan for Landscape Resilience and Connectivity

Action	**Partners /Programs**	**Effectiveness Measures**
Field surveys to document and monitor the abundance, distribution, trends, and movement of priority species in resilient and connected landscapes	• WVDNR & partners, public land managers, private landowners	• # of new occurrences documented and monitored
Protection of Resilient, Connected Landscapes • Conservation Easements	• County Farmland Protection Boards • Cacapon and Lost Rivers Land Trust • WV Land Trust • The Nature Conservancy • NRCS ACEP	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Protection of Resilient, Connected Landscapes • Land use planning	• County Planning Commissions	• Acres of habitat protected through land use planning in resilient, connected landscapes
Protection of Resilient, Connected Landscapes • Incentive Programs	• FSA CRP and CREP	• Acres of habitat protected for priority species in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats
Protection of Resilient, Connected Landscapes • Conservation and Management	• US Forest Service • WV Division of Natural Resources • Private Landowners • Partner Organizations	• Acres of habitat protected, restored, and maintained in resilient landscapes and climate corridors • Abundance & distribution of priority species and habitats

Conclusion

Habitat Conservation Priorities

This action plan lists priority species and rare plant communities targeted for conservation action on public and private land and within each major habitat type. The major habitat types include forests and woodlands, barrens, cliffs and talus, caves and karst, aquatic, riparian and floodplain habitats, and developed and agricultural habitats. For each major habitat type the plan identifies stresses that affect priority species, conservation actions to reduce those stresses, climate stresses on those habitats and actions to boost resilience, partners that can assist with conservation actions to implement the plan, and the human benefits of conservation.

Below is a list of the priority habitats identified by this Action Plan for conservation action within each major habitat type.

- Large, intact forest patches, including interior forest habitat
- Early successional forest habitat
- Small areas of unique, geologically derived habitat including:
    - Acidic rock outcrops, cliffs and talus
    - Calcareous cliffs and talus
    - Shale barrens
- Areas with karst geology and caves, and their watersheds
- Buffer areas surrounding biologically significant caves
- Special aquatic habitats, such as mussel streams, brook trout habitat patches and wetlands
- Small stream riparian and river floodplain habitats
- Riparian corridors, wetlands, fallow fields, field borders and other areas of natural and woody vegetation within and around agricultural lands.

These priority habitats include habitat cores and corridors that are critical for maintaining wildlife populations in this CFA. To protect priority SGCN and enable them to adapt to changing conditions within these priority habitats, landowners and partner organizations are encouraged to plan and implement conservation actions to alleviate stresses on priority species and boost habitat resilience, and carefully monitor the results using an adaptive management framework such as the Climate Smart Conservation Cycle included in the introduction. Stakeholders are also encouraged to coordinate with relevant agencies to develop strategies to avoid, minimize and mitigate for impacts to these priority habitats.

Integration of Conservation Actions

Integration of conservation actions within the above priority habitats, such as projects to improve mussel stream habitat by improving wastewater treatment, enlarging stream crossings and plant riparian stream buffers may benefit multiple plant communities and wildlife species. Coordinating actions across multiple habitats, such as protecting large patches of diverse forest habitats that also include rare shale barrens, rock outcrops or cliff and talus habitats, or improving water quality and

planting riparian corridors in karst landscapes or cave watersheds, may benefit additional species. Private landowners, public land managers and conservation partners are encouraged to focus resources across habitats to maximize benefits to multiple species in areas targeted for action in ways.

Connecting Conservation Actions for Climate Resilience

As we have seen, conservation actions to relieve stresses on priority species and efforts to boost the resilience of wildlife habitat are essential for enabling climate adaptation. Maintaining and protecting areas of high landscape integrity as well as the regional network of resilient lands, climate corridors, and flow zones is also critical for enabling wildlife species to adapt to changing conditions and shift across the landscape. Furthermore, creating local networks of connected habitat cores and corridors will enhance their resilience and connectivity, and the ability of wildlife species to adapt to changing conditions within this CFA. Connected local networks of headwater streams and larger rivers, their riparian corridors, floodplains, and wetlands enhances the stability of these habitats and enables fish, reptiles, birds, and other priority wildlife species that depend on those habitats to move across the landscape as conditions change. Maintaining connections between patches of diverse forest habitat and with rare shale barrens, rock outcrops, cliff and talus, karst or cave habitat buffers enhances the resilience of these habitats and enables forest species to move to optimal sites as conditions change. Conservation of aquatic, riparian and floodplain corridors along with areas of native vegetation in and around agricultural areas, small forest patches and larger blocks of forest habitat can create a local network of resilient, connected lands that merges into the larger regional network. Beyond undertaking conservation actions in the priority habitats listed above, and even beyond protecting the regional network of climate connectors and flow zones, stakeholders are encouraged to restore and protect the connections between these areas in order to maintain an interwoven fabric of natural systems for wildlife within this CFA to thrive long into the future.

Next Steps in Implementation

WVDNR engaged a working group of partner organizations and public land managers in developing this Action Plan and will seek to remain engaged by convening semi-annual meetings with the working group to collaborate on actions including the following:

- Planning, implementing, and evaluating ongoing field surveys of priority species to document and monitor their abundance, distribution, population trends, vulnerability, and range shifts
- Planning, implementing, monitoring, and evaluating the results of the conservation actions; and
- Engaging and supporting private landowners in this work

WVDNR may lead some of these efforts but will most often play the role of supporting efforts by the many partners active in this CFA with ongoing projects, established programs, and connections with landowners. In the case of public lands, WVDNR will also seek to incorporate conservation actions targeting priority species, habitats, and priority areas for conservation action into agency planning processes and support those actions. WVDNR will also work with state agencies and other authorities to promote avoidance, minimization, and mitigation for development impacts to priority habitats and other priority areas for conservation action.

References

Association of Fish and Wildlife Agencies. 2011. Measuring the Effectiveness of State Wildlife Grants: Final Report. 178 pp. http://www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf

Anderson, M.G., M. Clark, C.E. Feree, A. Jospe, A. Olivero Sheoldon, and K.J. Weaver. 2013. Northeast Habitat Guides: A companion to the terrestrial and aquatic habitat maps. The Nature Conservancy, Easstern Conservation Science, Eastern Regional Office. Boston, MA. http://naturel.ly/HabitatGuide

Anderson, M,G., A. Barnett, M. Clark, C. Ferree, Al. Olivero Sheldon, J. Prince. 2016a. Resilient Sites for Terrestrial Conservation in Eastern North America. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. http://easterndivision.s3.amazonaws.com/Resilient_Sites_for_Terrestrial_Conservation.pdf

Anderson, M,G., A. Barnett, M. Clark, J. Prince, A. Olivero Sheldon, and B. Vickery. 2016b. Resilient and Connected Landscapes for Terrestrial Conservation. The Nature Conservancy, Eastern Conservation Science, Eastern Regional Office. Boston, MA. http://easterndivision.s3.amazonaws.com/Resilient_and_Connected_Landscapes_For_Terrestial_Conservation.pdf

Butler, Patricia R.; Iverson, Louis; Thompson, Frank R., III; Brandt, Leslie; Handler, Stephen; Janowiak, Maria; Shannon, P. Danielle; Swanston, Chris; Karriker, Kent; Bartig, Jarel; Connolly, Stephanie; Dijak, William; Bearer, Scott; Blatt, Steve; Brandon, Andrea; Byers, Elizabeth; Coon, Cheryl; Culbreth, Tim; Daly, Jad; Dorsey, Wade; Ede, David; Euler, Chris; Gillies, Neil; Hix, David M.; Johnson, Catherine; Lyte, Latasha; Matthews, Stephen; McCarthy, Dawn; Minney, Dave; Murphy, Daniel; O'Dea, Claire; Orwan, Rachel; Peters, Matthew; Prasad, Anantha; Randall, Cotton; Reed, Jason; Sandeno, Cynthia; Schuler, Tom; Sneddon, Lesley; Stanley, Bill; Steele, Al; Stout, Susan; Swaty, Randy; Teets, Jason; Tomon, Tim; Vanderhorst, Jim; Whatley, John; Zegre, Nicholas. 2015. Central Appalachians forest ecosystem vulnerability assessment and synthesis: a report from the Central Appalachians Climate Change Response Framework project. U.S.D.A. Forest Service, Northern Research Station, General Technical Report NRS-146. Newtown Square, PA. 310 p. https://doi.org/10.2737/NRS-GTR-146.

Byers, E. and S. Norris. 2011. Climate change vulnerability assessment of species of concern in West Virginia. Project report to the West Virginia Division of Natural Resources, Elkins, WV. 69 pg. https://www.wvdnr.gov/publications/PDFFiles/ClimateChangeVulnerability.pdf

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S Menard, M. Pyne, M. Reid, K. Schulz, K. Snow and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, Virginia. http://www.natureserve.org/library/usEcologicalsystems.pdf

Gawler, S.C. 2008. Northeastern Terrestrial Wildlife Habitat Classification. Report to the Virginia Department of Game and Inland Fisheries on behalf of the Northeast Association of Fish and Wildlife Agencies and the National Fish and Wildlife Foundation. NatureServe, Boston, Massachusetts. 102 pp.

George Washington National Forest. 2014. Revised Land and Resource Management Plan. USDA Forest Service, Region 8, R8_MB 143 A. https://www.fs.fed.us/gwjeff/core/2014-GWNF-Revised-Forest-Plan-full-document.pdf

Harrison, Laura and Odell, Simon. 2016. Connectivity and ecological networks: Technical Information Note 01/2016. Research Report. The Landscape Institute, White Rose, U.K. https://eprints.whiterose.ac.uk/106609/1/Landscape_Institute_2016_Connectivity_and_Ecological_Networks.pdf

Homer, C., C. Huang, L. Yang, B. Wylie and M. Coan. 2004. Development of a 2001 National Landcover Database for the United States. Photogrammetric Engineering and Remote Sensing, vol. 170, No. 7, July 2004, pp. 829-840.

Janowiak, M., D. Dostie, M. Wilson, M. Kucera, R. Howard Skinner, J. Hatfield, D. Hollinger, and C. Swanston. 2016. Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. Technical Bulletin 1944. Washington, DC: U.S. Department of Agriculture. https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf

Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. Climate-Smart Conservation: Putting Adaptation Principles into Practice. National Wildlife Federation, Washington, D.C. https://www.nwf.org/-/media/PDFs/Global-Warming/2014/Climate-Smart-Conservation-Final_06-06-2014.ashx

Swanston, C., M. Janowiak, L. Brandt, P. Butler, S. Handler, P. Shannon, A. Lewis, K. Hall, R. Fahey, L. Scott, A. Kerber, J. Miesbauer, L. Darling, L. Parker and M. St. Pierre. 2016. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers, 2nd edition. USDA Forest Service, Northern Research Station, General Technical Report NRS-87-2. Newtown Square, PA. https://www.nrs.fs.fed.us/pubs/52760

USDA Natural Resources Conservation Service. 2004. National Biology Handbook, Subpart B-Conservation Planning. Part 613: Conservation Corridor Planning at the Landscape level- Managing for Wildlife Habitat. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_009912.pdf

West Virginia Division of Natural Resources. 2015. 2015 West Virginia State Wildlife Action Plan. http://www.wvdnr.gov/2015%20West%20Virginia%20State%20Wildlife%20Action%20Plan%20Submittal.pdf

Appendix 1. SGCN in Cacapon River and Patterson Creek CFA

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Amphibians	Ambystoma jeffersonianum	Jefferson Salamander	S2	G4
Amphibians	Ambystoma opacum	Marbled Salamander	S4	G5
Amphibians	Desmognathus fuscus	Northern Dusky Salamander	S5	G5
Amphibians	Desmognathus monticola	Seal Salamander	S5	G5
Amphibians	Eurycea bislineata	Northern Two-lined Salamander	S5	G5
Amphibians	Eurycea longicauda	Longtail Salamander	S5	G5
Amphibians	Gyrinophilus porphyriticus	Northern Spring Salamander	S5	G5T5
Amphibians	Plethodon glutinosus	Slimy Salamander	S5	G5
Amphibians	Plethodon hoffmani	Valley And Ridge Salamander	S4	G5
Amphibians	Plethodon punctatus	Cow Knob (White Spotted) Salamander	S2	G3
Amphibians	Plethodon virginia	Shenandoah Mountain Salamander	S2	G2G3Q
Amphibians	Plethodon cylindraceus	White-spotted Slimy Salamander	S5	G5
Amphibians	Pseudotriton ruber	(northern) Red Salamander	S3	G5
Amphibians	Anaxyrus fowleri	Fowler's Toad	S5	G5
Amphibians	Acris crepitans	Northern Cricket Frog	S2	G5
Amphibians	Pseudacris feriarum	Upland Chorus Frog	S3	G5
Amphibians	Scaphiopus holbrookii	Eastern Spadefoot	S1	G5
Birds	Butorides virescens	Green Heron	S3B	G5
Birds	Anas rubripes	American Black Duck	S2B,S2N	G5
Birds	Mergus merganser	Common Merganser	S3B,S3N	G5
Birds	Pandion haliaetus	Osprey	S2B	G5
Birds	Haliaeetus leucocephalus	Bald Eagle	S3B,S3N	G5
Birds	Buteo platypterus	Broad-winged Hawk	S3B	G5
Birds	Aquila chrysaetos	Golden Eagle	S3N	G5
Birds	Falco sparverius	American Kestrel	S3B	G5
Birds	Falco peregrinus	Peregrine Falcon	S2B,S2N	G4
Birds	Bonasa umbellus	Ruffed Grouse	S3B,S3N	G5
Birds	Colinus virginianus	Northern Bobwhite	S1B, S1N	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Birds	Porzana carolina	Sora	S1B,S1N	G5
Birds	Actitis macularius	Spotted Sandpiper	S2B	G5
Birds	Scolopax minor	American Woodcock	S3B	G5
Birds	Coccyzus erythropthalmus	Black-billed Cuckoo	S2B	G5
Birds	Tyto alba	Barn Owl	S2B,S2N	G5
Birds	Asio otus	Long-eared Owl	S1B,S1N	G5
Birds	Antrostomus vociferus	Eastern Whip-poor-will	S3B	G5
Birds	Chaetura pelagica	Chimney Swift	S3B	G5
Birds	Melanerpes erythrocephalus	Red-headed Woodpecker	S3B,S3N	G5
Birds	Sphyrapicus varius	Yellow-bellied Sapsucker	S2B,S3N	G5
Birds	Eremophila alpestris	Horned Lark	S2B,S3N	G5
Birds	Riparia	Bank Swallow	S2B	G5
Birds	Petrochelidon pyrrhonota	Cliff Swallow	S3B	G5
Birds	Certhia familiaris	Brown Creeper	S3B	G5
Birds	Hylocichla mustelina	Wood Thrush	S3B	G5
Birds	Lanius ludovicianus migrans	Migrant Loggerhead Shrike	S1B,S1N	G4T3Q
Birds	Vermivora cyanoptera	Blue-winged Warbler	S3B	G5
Birds	Vermivora chrysoptera	Golden-winged Warbler	S1B	G4
Birds	Setophaga caerulescens	Black-throated Blue Warbler	S3B	G5
Birds	Setophaga discolor	Prairie Warbler	S3B	G5
Birds	Setophaga cerulea	Cerulean Warbler	S2B	G4
Birds	Helmitheros vermivorum	Worm-eating Warbler	S3B	G5
Birds	Parkesia motacilla	Louisiana Waterthrush	S3B	G5
Birds	Icteria virens	Yellow-breasted Chat	S3B	G5
Birds	Piranga rubra	Summer Tanager	S3B	G5
Birds	Spiza americana	Dickcissel	S1B	G5
Birds	Spizella pallida	Clay-colored Sparrow	S1B	G5
Birds	Spizella pusilla	Field Sparrow	S3B	G5
Birds	Pooecetes gramineus	Vesper Sparrow	S2B, S2N	G5
Birds	Ammodramus savannarum	Grasshopper Sparrow	S3B	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Birds	Ammodramus henslowii	Henslow's Sparrow	S1B	G4
Birds	Dolichonyx oryzivorus	Bobolink	S3B	G5
Birds	Sturnella magna	Eastern Meadowlark	S3B, S2N	G5
Fish	Anguilla rostrata	American Eel	S2	G4
Fish	Notropis amoenus	Comely Shiner	S3	G5
Fish	Notropis procne	Swallowtail Shiner	S1	G5
Fish	Cyprinella analostana	Satinfin Shiner	S1	G5
Fish	Luxilus cornutus	Common Shiner	S1S2	G5
Fish	Lythrurus ardens	Rosefin Shiner	S1	G5
Fish	Erimyzon oblongus	Creek Chubsucker	S3	G5
Fish	Moxostoma macrolepidotum	Shorthead Redhorse	S1	G5
Fish	Ameiurus nebulosus	Brown Bullhead	S2	G5
Fish	Fundulus diaphanus	Banded Killifish	S2	G5
Fish	Etheostoma olmstedi	Tessellated Darter	S1S2	G5
Mammals	Myotis sodalis	Indiana Bat	S1	G2
Mammals	Myotis leibii	Eastern Small-footed Bat	S1	G3
Mammals	Myotis septentrionalis	Northern Myotis	S2*	G2G3
Mammals	Corynorhinus townsendii virginianus	Virginia Big-eared Bat	S2	G4T2
Mammals	Sylvilagus obscurus	Appalachian Cottontail	S2	G4
Mammals	Neotoma magister	Allegheny Woodrat	S3	G3G4
Mammals	Zapus hudsonius	Meadow Jumping Mouse	S3	G5
Mammals	Erethizon dorsatum	Porcupine	S3	G5
Mammals	Spilogale putorius	Eastern Spotted Skunk	S1	G5
Reptiles	Clemmys guttata	Spotted Turtle	S1	G5
Reptiles	Glyptemys insculpta	Wood Turtle	S3	G4
Reptiles	Pseudemys rubriventris	Northern Red-bellied Cooter	S2	G5
Reptiles	Terrapene carolina	Eastern Box Turtle	S5	G5T5
Reptiles	Plestiodon anthracinus	Northern Coal Skink	S2	G5T5
Reptiles	Scincella lateralis	Little Brown Skink	S2	G5
Reptiles	Carphophis amoenus	Wormsnake	S3	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Reptiles	Coluber constrictor	Northern Black Racer	SNR	G5T5
Reptiles	Diadophis punctatus edwardsii	Northern Ring-necked Snake	S5	G5T5
Reptiles	Pantherophis guttatus	Red Cornsnake	S1	G5
Reptiles	Heterodon platirhinos	Eastern Hog-nosed Snake	S2	G5
Reptiles	Lampropeltis getula	Eastern Kingsnake	S2	G5
Reptiles	Regina septemvittata	Queen Snake	S4	G5
Reptiles	Thamnophis sauritus	Eastern Ribbonsnake	S2	G5
Reptiles	Liochlorophis vernalis	Smooth Greensnake	S5	G5
Reptiles	Agkistrodon contortrix mokasen	Northern Copperhead	S5	G5T5
Reptiles	Crotalus horridus	Timber Rattlesnake	S3	G4
Cave Invertebrates	Stygobromus franzi	Franz's Cave Amphipod	S1	G3G4
Cave Invertebrates	Stygobromus allegheniensis	Allegheny Cave Amphipod	S1	G5
Cave Invertebrates	Stygobromus morrisoni	Morrison's Cave Amphipod	S1	G2G3
Cave Invertebrates	Onychiurus janus	A Cave Springtail	S1	G2G3
Cave Invertebrates	Zygonopus krekeleri	West Virginia Blind Cave Millipede	S1	G4
Cave Invertebrates	Phanetta subterranea	A Spider	S3	G5
Tiger Beetles	Cicindela ancocisconensis	Appalachian Tiger Beetle	S3	G3
Tiger Beetles	Cicindela unipunctata	A Tiger Beetle	S3	G4G5
Butterflies and Moths	Erynnis martialis	Mottled Duskywing	S3	G3
Butterflies and Moths	Erynnis lucilius	Columbine Duskywing	S2	G4
Butterflies and Moths	Pyrgus (centaureae) wyandot	Grizzled Skipper	S1	G1G2Q
Butterflies and Moths	Hesperia metea	Cobweb Skipper	S2S3	G4G5
Butterflies and Moths	Papilio appalachiensis	Appalachian Tiger Swallowtail	SNR	G4
Butterflies and Moths	Pieris virginiensis	West Virginia White	S3	G3?
Butterflies and Moths	Euchloe olympia	Olympia Marble	S2S3	G4G5
Butterflies and Moths	Satyrium edwardsii	Edwards' Hairstreak	S2	G4
Butterflies and Moths	Parrhasius m-album	White-m Hairstreak	S2	G5
Butterflies and Moths	Glaucopsyche l. lygdamus	Silvery Blue	S4	G5T3T4
Butterflies and Moths	Calephelis borealis	Northern Metalmark	S2	G3G4
Butterflies and Moths	Boloria selene myrina	Silver-bordered Fritillary	S3	G5T5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Butterflies and Moths	Chlosyne harrisii	Harris's Checkerspot	S2	G4
Butterflies and Moths	Euchlaena milnei	Milne's Euchlaena Moth	S2	G2G4
Butterflies and Moths	Zale calycanthata	Double-banded Zale	SU	G4
Butterflies and Moths	Acronicta dolli	Doll's Merolonche	SH	G3G4
Dragonflies and Damselflies	Tachopteryx thoreyi	Gray Petaltail	S3	G4
Dragonflies and Damselflies	Cordulegaster erronea	Tiger Spiketail	S2	G4
Dragonflies and Damselflies	Cordulegaster obliqua	Arrowhead Spiketail	S2	G4
Dragonflies and Damselflies	Dromogomphus spoliatus	Flag-tailed Spinyleg	SH	G4G5
Dragonflies and Damselflies	Gomphus lineatifrons	Splendid Clubtail	S2	G4
Dragonflies and Damselflies	Gomphus rogersi	Sable Clubtail	S1	G4
Dragonflies and Damselflies	Gomphus descriptus	Harpoon Clubtail	S2S3	G4
Dragonflies and Damselflies	Gomphus quadricolor	Rapids Clubtail	S3	G3G4
Dragonflies and Damselflies	Gomphus abbreviatus	Spine-crowned Clubtail	SH	G3G4
Dragonflies and Damselflies	Gomphus viridifrons	Green-faced Clubtail	S3	G3G4
Dragonflies and Damselflies	Lanthus parvulus	Northern Pygmy Clubtail	S3	G4
Dragonflies and Damselflies	Ophiogomphus carolus	Riffle Snaketail	S2	G5
Dragonflies and Damselflies	Ophiogomphus rupinsulensis	Rusty Snaketail	S2	G5
Dragonflies and Damselflies	Aeshna tuberculifera	Black-tipped Darner	S3	G4
Dragonflies and Damselflies	Aeshna verticalis	Green-striped Darner	S2S3	G5
Dragonflies and Damselflies	Macromia alleghaniensis	Allegheny River Cruiser	S2S3	G4
Dragonflies and Damselflies	Macromia illinoiensis	Illinois River Cruiser	S3	G5
Dragonflies and Damselflies	Macromia taeniolata	Royal River Cruiser	S3	G5
Dragonflies and Damselflies	Cordulia shurtleffi	American Emerald	S4	G5
Dragonflies and Damselflies	Helocordulia uhleri	Uhler's Sundragon	S2S3	G5
Dragonflies and Damselflies	Libellula axilena	Bar-winged Skimmer	S2	G5
Dragonflies and Damselflies	Libellula flavida	Yellow-sided Skimmer	S3	G5
Dragonflies and Damselflies	Ladona deplanata	Blue Corporal	S3	G5
Dragonflies and Damselflies	Sympetrum obtrusum	White-faced Meadowhawk	S3	G5
Dragonflies and Damselflies	Calopteryx angustipennis	Appalachian Jewelwing	S3	G4
Dragonflies and Damselflies	Lestes forcipatus	Sweetflag Spreadwing	S3	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Dragonflies and Damselflies	Lestes australis	Southern Spreadwing	S3	G5
Dragonflies and Damselflies	Enallagma annexum	Northern Bluet	S3	G5
Dragonflies and Damselflies	Enallagma vesperum	Vesper Bluet	S3	G5
Mussels	Alasmidonta undulata	Triangle Floater	S1	G4
Mussels	Alasmidonta varicosa	Brook Floater	S2	G3
Mussels	Elliptio complanata	Eastern Elliptio	S2	G5
Mussels	Elliptio fisheriana	Northern Lance	S2	G4
Mussels	Lampsilis cariosa	Yellow Lampmussel	S2	G3G4
Mussels	Lampsilis radiata	Eastern Lampmussel	S1	G5
Mussels	Lasmigona subviridis	Green Floater	S2	G3
Mussels	Strophitus undulatus	Squawfoot	S3	G5
Mussels	Pyganodon cataracta	Eastern Floater	S2	G5
Snails	Hendersonia occulta	Cherrystone Drop	S3	G4
Snails	Glyphyalinia cumberlandiana	Hill Glyph	S3	G4
Snails	Striatura exigua	Ribbed Striate	S2	G5
Snails	Ventridens arcellus	Golden Dome	S3	G4
Snails	Ventridens collisella	Sculptured Dome	S3	G4G5
Snails	Ventridens suppressus	Flat Dome	S3	G5
Snails	Ventridens virginicus	Split-tooth Dome	S3	G4
Snails	Stenotrema simile	Bear Creek Slitmouth	S2	G2
Snails	Triodopsis fallax	Mimic Threetooth	S3	G5
Snails	Striatura exigua	Ribbed Striate	S2	G5
Snails	Triodopsis vulgata	Dished Threetooth	S2	G5
Snails	Ventridens coelaxis	Bidentate Dome	S1	G3
Snails	Ventridens suppressus	Flat Dome	S3	G5
Plants	Toxicodendron vernix	Poison-sumac	S2	G5
Plants	Hydrocotyle ranunculoides	Swamp Pennywort	S2	G5
Plants	Ptilimnium fluviatile	Harperella	S1	G2
Plants	Taenidia montana	Mountain-pimpernel	S3	G3
Plants	Coreopsis verticillata	Whorled Tickseed	S1	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Plants	Rudbeckia fulgida var. fulgida	Orange Coneflower	S2	G5T4?
Plants	Packera antennariifolia	Shalebarren Ragwort	S3	G4
Plants	Packera paupercula	Balsam Ragwort	S2	G5
Plants	Solidago arguta var. harrisii	Shalebarren Goldenrod	S3	G5T4
Plants	Ageratina aromatica var. aromatica	Small White Snakeroot	S1	G5T5
Plants	Betula papyrifera	Paper Birch	S2	G5
Plants	Arabis patens	Spreading Rockcress	S2	G3
Plants	Descurainia pinnata ssp. brachycarpa	Tansy Mustard	SH	G5T5
Plants	Campanula rotundifolia	Bluebell Bellflower	S3	G5
Plants	Minuartia groenlandica	Greenland Stitchwort	S1	G5
Plants	Paronychia argyrocoma	Silvery Nailwort	S3	G4
Plants	Paxistima canbyi	Canby's Mountain-lover	S2	G2
Plants	Helianthemum canadense	Long-branch Frostweed	S2	G5
Plants	Calystegia spithamaea ssp. purshiana	Shale Bindweed	S3	G4G5T4
Plants	Cornus canadensis	Canadian Bunchberry	S2	G5
Plants	Linnaea borealis ssp. americana	Twinflower	S1	G5T5
Plants	Symphoricarpos albus var. albus	Snowberry	S2	G5T5
Plants	Viburnum rafinesquianum	Downy Arrow-wood	S2	G5
Plants	Cuscuta indecora var. neuropetala	Dodder	S1	G5T5
Plants	Drosera rotundifolia var. rotundifolia	Roundleaf Sundew	S3	G5T5
Plants	Arctostaphylos uva-ursi	Kinniinnick	S1	G5
Plants	Gaylussacia brachycera	Box Huckleberry	S2	G3
Plants	Vaccinium macrocarpon	Large Cranberry	S3	G4
Plants	Euphorbia pubentissima	False Flowering Spurge	S1	G5
Plants	Astragalus distortus var. distortus	Bent Milkvetch	S2	G5T5?
Plants	Baptisia australis var. australis	False Blue Indigo	S3	G5T3T4
Plants	Desmodium lineatum	Tick-trefoil	S1	G5
Plants	Galactia volubilis	Downy Milkpea	S2	G5
Plants	Lupinus perennis ssp. perennis	Wild Lupine, Sundial Lupine	S1	G5T4?
Plants	Trifolium reflexum	Buffalo Clover	S1	G3G4

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Plants	Trifolium virginicum	Kate's Mountain Clover	S3	G3
Plants	Quercus shumardii	Shumard Oak	S2	G5
Plants	Adlumia fungosa	Allegheny-vine	S2?	G4
Plants	Juglans cinerea	Butternut	S3	G4
Plants	Pycnanthemum clinopodioides	Basil Mountain-mint	SH	G2
Plants	Scutellaria ovata ssp. ovata	Heart-leaved Skullcap	S1	G5T5
Plants	Trichostema setaceum	Narrowleaf Bluecurls	S2	G5
Plants	Linum lewisii var. lewisii	Prairie Flax	S2	G4G5T4T5
Plants	Hibiscus laevis	Halberd-leaf Rosemallow	S2	G5
Plants	Fraxinus nigra	Black Ash	S2	G5
Plants	Oenothera argillicola	Shalebarren Evening-primrose	S3	G3G4
Plants	Samolus valerandi ssp. parviflorus	Seaside Brookweed	S2	G5T5
Plants	Clematis albicoma	White-hair Leatherflower	S3	G4
Plants	Clematis occidentalis var. occidentalis	Purple Virgin's Bower	S2	G5T5
Plants	Delphinium exaltatum	Tall Larkspur	S2	G3
Plants	Ranunculus pusillus var. pusillus	Low Spearwort	S1	G5T4?
Plants	Ranunculus trichophyllus var. trichophyllus	Threadleaf Water Crowfoot	SH	G5T5
Plants	Prunus alleghaniensis var. alleghaniensis	Allegheny Plum	S3	G4T4
Plants	Rosa acicularis ssp. sayi	Bristly Rose	S1	G5T5
Plants	Sanguisorba canadensis	Canada Burnet	S2S3	G5
Plants	Sibbaldiopsis tridentata	Mountain-cinquefoil	S2	G5
Plants	Heuchera americana var. hispida	Rough Alumroot, Rough Heuchera	S2	G5T3?
Plants	Heuchera alba	White Alumroot	S2	G2Q
Plants	Saxifraga pensylvanica	Eastern Swamp Saxifrage	S2	G5
Plants	Lindernia dubia var. anagallidea	Yellowseed False Pimpernel	S2	G5T4
Plants	Pedicularis lanceolata	Swamp Lousewort	S2	G5
Plants	Veronica scutellata	Grassleaf Speedwell	S2	G5
Plants	Thuja occidentalis	Northern White-cedar	S2	G5
Plants	Taxus canadensis	Canada Yew	S2S3	G5
Plants	Commelina erecta	Slender Dayflower	S2	G5T5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Plants	Carex bromoides ssp. bromoides	Brome-like Sedge	S3	G5T5
Plants	Carex buxbaumii	Brown Bog Sedge	S2	G5
Plants	Carex davisii	Davis' Sedge	S1	G4
Plants	Carex eburnea	Bristleleaf Sedge	S3	G5
Plants	Carex emoryi	Emory's Sedge	S2	G5
Plants	Carex pellita	Woolly Sedge	S2	G5
Plants	Carex nigromarginata	Black-edge Sedge	S3	G5
Plants	Carex normalis	Greater Straw Sedge	S3	G5
Plants	Carex projecta	Necklace Sedge	S3	G5
Plants	Carex tonsa var. rugosperma	Parachute Sedge	S2S3	G5T5
Plants	Carex tonsa var. tonsa	Shaved Sedge	S1	G5T5
Plants	Carex planispicata	Flat-spiked Sedge	S2	G4Q
Plants	Scirpus ancistrochaetus	Barbed-bristle Bulrush	S1	G3
Plants	Trichophorum planifolium	Bashful Bulrush	S1	G4G5
Plants	Elodea nuttallii	Western Waterweed	S3	G5
Plants	Juncus scirpoides	Needle-pod Rush	S2	G5
Plants	Juncus torreyi	Torrey's Rush	S2	G5
Plants	Juncus biflorus	Bog Rush	S2	G5
Plants	Lemna valdiviana	Pale Duckweed	S3	G5
Plants	Stenanthium gramineum var. gramineum	Featherbells	S2S3	G4G5T3T5
Plants	Trillium nivale	Snowy Trillium	S2	G4
Plants	Xerophyllum asphodeloides	Eastern Turkeybeard	S1	G4
Plants	Zigadenus elegans ssp. glaucus	Mountain Deathcamas	S1	G5T4T5
Plants	Zigadenus leimanthoides	Pine Barren Deathcamas	S2	G4Q
Plants	Najas gracillima	Slender Waternymph	S2	G5?
Plants	Corallorhiza wisteriana	Wister's Coralroot, Spring Coralroot	S2	G5
Plants	Hexalectris spicata var. spicata	Spiked Crested Coralroot	S1	G5T4T5
Plants	Liparis loeselii	Yellow Wide-lip Orchid	S3	G5
Plants	Platanthera ciliaris	Yellow-fringe Orchid	S3	G5
Plants	Pogonia ophioglossoides	Rose Pogonia	S2	G5

TAXA	SCIENTIFIC NAME	COMMON NAME	S-RANK	G-RANK
Plants	Spiranthes tuberosa	Little Ladies'-tresses	S3	G5
Plants	Bouteloua curtipendula var. curtipendula	Sideoats Grama	S3	G5T5
Plants	Calamagrostis porteri ssp. porteri	Reedgrass	S3	G4T4
Plants	Diarrhena obovata	Twin Grass	S1	G4G5
Plants	Dichanthelium boreale	Panicgrass	S1	G5
Plants	Dichanthelium xanthophysum	Panicgrass	SH	G5
Plants	Dichanthelium meridionale	Matting Witchgrass	S3	G5
Plants	Digitaria filiformis	Slender Crabgrass	S1	G5
Plants	Glyceria acutiflora	Creeping Mannagrass	S2	G5
Plants	Glyceria laxa	Mannagrass	S2S3	G5
Plants	Hierochloe hirta ssp. arctica	Holy Grass, Sweetgrass	S1	G5T5
Plants	Melica nitens	Three-flower Melicgrass	S1	G5
Plants	Piptatherum racemosum	Black-seed Mountain Ricegrass	S2	G5
Plants	Piptochaetium avenaceum	Eastern Speargrass	S2	G5
Plants	Heteranthera reniformis	Kidneyleaf Mud-plantain	S1	G5
Plants	Potamogeton illinoensis	Illinois Pondweed	S2	G5
Plants	Potamogeton spirillus	Spiral Pondweed	S2	G5
Plants	Cheilanthes eatonii	Chestnut Lipfern	S2	G5?
Plants	Woodwardia areolata	Netted Chainfern	S2	G5
Plants	Gymnocarpium appalachianum	Appalachian Oak Fern	S2	G3
Plants	Gymnocarpium dryopteris	Northern Oak Fern	S1	G5
Plants	Woodsia ilvensis	Rusty Cliff Fern	S2	G5
Plants	Equisetum sylvaticum	Woodland Horsetail	S1	G5
Plants	Ophioglossum pusillum	Northern Adder's-tongue	SH	G5

Appendix 2. Priority SGCN, Known Stresses and Actions

Agricultural Habitats		
COMMON_NAME	**Local Stress**	**Action**
American Kestrel	• Insufficient nest microhabitat • Residential development	• Nest box installation and monitoring
American Woodcock	• Insufficient habitat	• Reduce clean farming practices • Create early successional habitat
Barn Owl	• Insufficient nest microhabitat • Clean farming practices • Poisoning	• Install and monitor nest boxes • Outreach to landowners to reduce rodenticide use
Bobolink	• Clean farming practices • Nest loss from early haying	• Delay hay harvest until July 15 • Prevent conversion of grasslands to croplands
Eastern Meadowlark	• Clean farming practices • Nest loss from early haying	• Delay hay harvest until July 15 • Prevent conversion of grasslands to croplands
Field Sparrow	• Clean farming practices • Residential development	• Retain or plant shrubs in fields • Retain or plant hedgerows
Grasshopper Sparrow	• Clean farming practices • Nest loss from early haying	• Delay hay harvest until July 15 • Prevent conversion of grasslands to croplands
Migrant Loggerhead Shrike	• Clean farming practices	• Retain or plant hawthorns in pastures, retain or plant hedgerows
Northern Bobwhite	• Insufficient habitat • Predation	• Reduce clean farming practices, Forest management to create early successional habitat
Vesper Sparrow	• Clean farming practices • Nest loss from early haying	• Delay hay harvest until July 15 • Prevent conversion of grasslands to croplands
Yellow-breasted Chat	• Forest maturation • Herbicide use and vegetation management in utility corridors	• Manage forests to create early successional habitat • Develop BMP's for managing rights of way corridors
Developed Lands		
COMMON_NAME	**Local Stress**	**Action**
Barn Owl	• Insufficient nest microhabitat • Clean farming practices, poisoning	• Install and monitor nest boxes, outreach to landowners to reduce rodenticides
Chimney Swift	• Chimney capping • Turnover of older structures	• Landowner outreach and education • Uncap chimneys • Install swift towers

Caves and Karst		
COMMON_NAME	**Local Stress**	**Action**
A Cave Springtail (*Onychiurus janus*)	• Land use changes	• Develop BMP's for landowner use • Install fencing to keep cattle out of streams • Riparian plantings (trees, shrubs) along streams
Allegheny Cave Amphipod	• Water quality of underground drainage from surface runoff	• Develop BMP's for landowner use • Install fencing to keep cattle out of streams • Riparian plantings (trees, shrubs) along streams
Franz's Cave Amphipod	• Water quality of underground drainage from surface runoff	• Develop BMP's for landowner use • Install fencing to keep cattle out of streams • Riparian plantings (trees, shrubs) along streams
Morrison's Cave Amphipod	• Water quality of underground drainage from surface runoff	• Develop BMP's for landowner use • Install fencing to keep cattle out of streams • Riparian plantings (trees, shrubs) along streams
West Virginia Blind Cave Millipede	• Land use changes	• Develop BMP's for landowner use • Install fencing to keep cattle out of streams • Riparian plantings (trees, shrubs) along streams

Forests and Woodlands		
COMMON_NAME	**Local Stress**	**Action**
Black-billed Cuckoo	• Insufficient habitat, pesticide exposure	• Create early successional habitat, reduce aerial application of pesticides
Broad-winged Hawk	• Unsuitable forest structure, residential development	• Land protection/conservation easements
Buffalo Clover	• Unknown location and population viability	• Survey to locate, relocate and delineate populations
Cerulean Warbler	• Unsuitable forest structure	• Manage forests to create suitable habitat as per CERW guidelines
Eastern Turkeybeard	• Increased herbaceous competition due to absence of fire	• Use prescribed fire in adjacent habitat
Golden Eagle	• Residential development	• Land protection/conservation easements
Golden-winged Warbler	• Forest maturation • Unsuitable forest structure	• Manage forests to create early successional habitat as per GWWA guidelines
Prairie Warbler	• Forest maturation • Herbicide use and vegetation management in utility corridors	• Manage forests to create early successional habitat • Develop BMP's for Right of Way management
Ruffed Grouse	• Insufficient habitat • West Nile Virus	• Create early successional habitat through forest management
Wild Lupine, Sundial Lupine	• Woody vegetation encroachment • Mowing and herbicide use along highways	• Create forest canopy gaps • Work with WVDOH to avoid mowing and herbicide use
Wood Thrush	• Deer overbrowsing • Residential development • Unsuitable forest structure	• Reduce deer population, manage forests for structural and spatial complexity
Wood Turtle	• Habitat fragmentation	• Maintain forest corridors between watersheds.
Worm-eating Warbler	• Unsuitable forest structure • Deer overbrowsing	• Manage forests for structural complexity • Reduce deer populations

Streams and Floodplains		
COMMON_NAME	**Local Stress**	**Action**
Allegheny River Cruiser	• Loss of water quality due to sedimentation and effluents	• Establish stream buffer zones & fencing • Improve wastewater treatment
American Eel	• Passage barriers between the Sargasso Sea and freshwater maturation areas	• Remove passage barriers • Install Eel ladders
Appalachian Jewelwing	• Loss of riparian vegetation and water quality	• Establish streamside buffer zones to reduce sedimentation and erosion
Bank Swallow	• Degradation of riparian corridors • Decline in aerial insects	• Monitor and survey nest colonies, outreach to landowners
Barbed-bristle Bulrush	• Lack of protected habitat; habitat change/above average rainfall	• Habitat protection and monitoring
Brook Floater	• Livestock access • Sedimentation	• Riparian corridor planting (trees, shrubs) • Install fencing to keep cattle out of streams
Common Shiner	• Warming instream water temperatures • Sedimentation • Hybridization and interspecific competition with Striped Shiners	• Establish riparian areas by not mowing, planting crops, disturbing soil, or grazing livestock to the edge of streambanks • Plant trees to create overhead canopy cover and reduce sedimentation • Install fencing to keep cattle out of streams • Do not introduce (bait) fish from outside the watershed.
Davis' Sedge	• Unknown location and population viability	• Survey to locate, relocate and delineate populations
Green Floater	• Sedimentation	• Establish riparian corridor by planting trees and shrubs • Install fencing to keep cattle out of streams
Harperella	• Increasing ice and water scour • Flash flooding • Streambed alteration	• Monitor harperella population's response to conservation measures • Establish riparian buffer by planting trees and shrubs • Use natural stream design to protect and restore streambed

Louisiana Waterthrush	• Stream corridor degradation • Acid deposition • Hemlock wooly adelgid	• Improve pH in streams by introducing lime • Treat remaining riparian hemlock stands
Satinfin Shiner	• Warming instream water temperatures • Sedimentation • Nutrification	• Establish riparian areas by reducing mowing, planting crops, disturbing soil, or grazing livestock to the edge of streambanks • Perform tree plantings to create overhead canopy cover and reduce sedimentation • Install fencing to keep cattle out of streams

Spine-crowned Clubtail	• Degraded water quality due to
	  ○ Sedimentation
	  ○ Sewage effluent
		• Establish riparian areas by reducing mowing, planting crops, disturbing soil, or grazing livestock to the edge of streambanks
		• Install fencing to keep cattle out of streams
		• Improve wastewater treatment
		• NPDES enforcement

Splendid Clubtail	• Degraded water quality due to
	  ○ Sedimentation
	  ○ Effluents
		• Establish riparian areas by reducing mowing, planting crops, disturbing soil, or grazing livestock to the edge of streambanks
		• Install fencing to keep cattle out of streams
		• Improved wastewater treatment
		• NPDES enforcement

Spotted Turtle	• Non-native invasive plants • Land use alteration • Climate change	• Treat cattails and other non-native invasive plants • Improve water quality
Triangle Floater	• Sedimentation • Cattle access	• Riparian corridor planting • Install fencing to keep cattle out of streams
Wood Turtle	• Degradation or lack of nesting habitat; • loss of instream habitat	• Create or establish instream woody habitat features
Yellow Lampmussel	• Sedimentation • Cattle access	• Riparian corridor planting • Install fencing to keep cattle out of streams
Yellow-sided Skimmer	• Loss of riparian vegetation • Degraded water quality	• Establish riparian areas by reducing mowing, planting crops, disturbing soil, or grazing livestock to the edge of streambanks

Appendix 3. Terrestrial and Aquatic Habitats in Public Lands

Public Land	Terrestrial Habitat	Aquatic Habitat
George Washington National Forest	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Calcareous Forests, Woodlands, and Glades • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Montane Red Oak Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands • Other Dry Oak Forests and Woodlands • Red Spruce Forests **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus • Calcareous Cliffs and Talus **Aquatic, Floodplain, and Riparian** • Open Water • River Floodplains • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, Low Gradient, Cool • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cold • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Cool
Short Mountain Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Mixed Mesophytic Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Open Water • Small Stream Riparian Habitats **Agricultural and Developed** • Developed	• Headwater Creek, Low Gradient, Warm • Headwater Creek, Moderate Gradient, Cool • Headwater Creek, High Gradient, Cool • Small River, Moderate Gradient, Warm

Public Land	Terrestrial Habitat	Aquatic Habitat
Edwards Run Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Other Dry Oak Forests and Woodlands **Aquatic, Floodplain, and Riparian** • Open Water • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture	• Headwater Creek, Moderate Gradient, Warm
Nathaniel Mountain Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Pine-Oak Rocky Woodlands **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, High Gradient, Cold
Sideling Hill Wildlife Management Area	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Small Stream Riparian Habitats **Agricultural and Developed** • Agriculture • Developed	• Headwater Creek, High Gradient, Cool

Public Land	Terrestrial Habitat	Aquatic Habitat
Cacapon Resort State Park	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Small Stream Riparian Habitats	• Headwater Creek, High Gradient, Cool
Lost River State Park	**Forest and Woodland** • Dry-Mesic Oak Forests • Dry Oak (-Pine) Forests • Mixed Mesophytic Forests • Montane Red Oak Forests • Northern Hardwood Forests • Pine-Oak Rocky Woodlands **Rock Outcrops, Cliffs and Talus, and Shale Barrens** • Acid Rock Outcrops, Cliffs, and Talus **Aquatic, Floodplain, and Riparian** • Small Stream Riparian Habitats **Agricultural and Developed** • Developed	• Headwater Creek, Moderate Gradient, Cool

Appendix 4. Partners and Assistance Provided

The table below lists partners and assistance provided to landowners for wildlife conservation actions in the CFA.

Partner	Role/Assistance Provided
West Virginia University Extension Service (WVU Extension): • Forestry https://extension.wvu.edu/natural-resources/forestry • Wildlife https://extension.wvu.edu/natural-resources/wildlife	• Landowner technical assistance and information on financial assistance for forest and wildlife management • Training workshops and conferences on forestry Best Management Practices and safety practices
US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program https://www.fws.gov/northeast/ecologicalservices/partners.html	• Provides technical and financial assistance to private landowners for restoration and enhancement of fish and wildlife habitat for the benefit of Federal Trust species (Migratory Birds, Threatened and Endangered, and At-Risk Species) • CFA is part of the program's Upper Potomac Priority Area • Efforts focus on controlling non-native invasive plants, managing livestock access to forests, wetland restoration, riparian buffer planting and fencing, in-stream habitat improvement, aquatic passage barrier removal, and creating pollinator habitat • Works in coordination with the USDA Natural Resources Conservation Service farm bill programs, Trout Unlimited and other partners
US Fish and Wildlife Service (USFWS) • Appalachian Fish and Wildlife Conservation Office https://www.fws.gov/northeast/apco/	• Works with partners to restore rivers, wetlands, and aquatic species in collaboration with Partners for Fish and Wildlife Program, National Fish Habitat Partnership and National Fish Passage Program • Provides technical assistance to private landowners to restore and enhance fish and wildlife habitat • Conducts outreach and education on aquatic resources with youth and their families

Partner	Role/Assistance Provided
USDA Natural Resources Conservation Service: https://www.nrcs.usda.gov/wps/portal/nrcs/site/wv/home/ • Environmental Quality Incentive Program (EQIP) • Conservation Stewardship Program (CSP) • Agricultural Conservation Easement Program (ACEP)	• EQIP provides cost-share to forest and agricultural landowners targeting needs such as reduction of nutrient, sediment and pesticide pollution and wildlife habitat enhancement, including stream buffers • EQIP funds in the Potomac Valley Conservation District have been prioritized for improved grazing and pasture management (including alternative water and fencing), nutrient management to protect streams, enhancing riparian corridors and natural stream restoration promoting brook trout in headwater streams. • CSP provides payments to farm and forest landowners for actively managing, maintaining, and expanding conservation activities to enhance natural resources and improve their business operations. CSP targets include forest management, riparian areas and wildlife habitat. • Ruffed Grouse Habitat Initiative in the Potomac Valley Conservation District to create early successional forest habitat for species including ruffed grouse, wild turkey, cerulean warbler and other neotropical migrants • ACEP can be used for both agricultural land easements and wetland reserve easements to protect farmland and associated habitat • Potomac Valley Conservation District, in partnership with NRCS, hosts a Local Work Group to identify and prioritize resource concerns, develop long range plans and evaluate EQIP applications for funding through the NRCS Focal Conservation Approach (FCA). • West Virginia funding pools include Conservation Activity Planning, Forest Management Implementation and Wildlife Habitat Conservation • Other funding initiatives target Golden Winged Warblers, Cerulean Warblers and Aquatic Organism Passage
USDA Farm Service Agency https://www.fsa.usda.gov/state-offices/West-Virginia/programs/index • Conservation Reserve Program (CRP) • Conservation Reserve Enhancement Program (CREP)	• CRP provides rental payments to participating agricultural producers to safeguard environmentally sensitive land, conserve water quality, control soil erosion and enhance wildlife habitat, including floodplain wetlands. • CREP provides extra incentives and payments to eligible producers in the Potomac watershed (including this CFA) to reduce soil erosion and pollution, improve water quality, and enhance terrestrial and aquatic wildlife habitat through practices such as riparian buffers and wetland restoration

Partner	Role/Assistance Provided
WV Division of Natural Resources (WVDNR) http://www.wvdnr.gov/wildlife/wdpintro.shtm	• Identify, survey and monitor SGCN and rare communities • Technical assistance on habitat management for SGCN • Facilitating partnerships to manage habitat for SGCN • Provide letters of support for partner proposals and grant applications seeking to benefit SGCN • Education, outreach, and teaching resources on SGCN and their habitat • Field guides, Landscaping and Management guidelines • Fish, game and wildlife research and management • Fishing and river access • Wildlife Management Areas
WV Department of Environmental Protection (WVDEP) • Nonpoint Source Program https://dep.wv.gov/WWE/Programs/nonptsource/Pages/home.aspx • Watershed Based Plans https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx • Chesapeake Bay Program https://dep.wv.gov/WWE/watershed/wqmonitoring/Pages/ChesapeakeBay.aspx • Save Our Streams Program https://dep.wv.gov/WWE/getinvolved/sos/Pages/default.aspx • Rehabilitation Environmental Action Plan (REAP) https://dep.wv.gov/environmental-advocate/reap/Pages/default.aspx • WVDEP Youth Environmental Program (YEP) https://dep.wv.gov/environmental-advocate/yep/Pages/default.aspx	• Supports partners and citizen-based watershed organizations in restoring impaired watersheds • Provides assistance in proper installation and maintenance of Best Management Practices • Provides funding for projects by watershed groups and partners to improve water quality in watersheds listed as impaired, with Watershed Based Plans, including the Lost River Watershed in this CFA • WV Chesapeake Bay funding for water quality improvements through the CFA • Practices include wastewater treatment, agricultural BMPs, rain gardens for stormwater runoff, streambank restoration, and community outreach • Save our Streams provides training for volunteers to monitor local wadable streams and rivers • REAP provides communities with technical, financial and resource assistance in cleanup efforts. • YEP organizes youth and volunteer groups for hands-on conservation projects

Partner	Role/Assistance Provided
WV Conservation Agency (WVCA) and Potomac Valley Conservation District (PVCD) http://www.wvca.us/	• Promotes the protection and conservation of West Virginia's soil, land, water, and related resources • Works with WVDEP on to improve water quality through the Non-Point Source and Chesapeake Bay programs • Works with Potomac Valley Conservation District to implement Agricultural Best Management Practices, such as invasive species management and exclusion fencing to protect streams, wetlands, and other environmentally sensitive areas • Potomac Valley Conservation District, in partnership with NRCS, hosts Local Work Group to identify and prioritize resource concerns and evaluate EQIP applications for funding through the NRCS Focal Conservation Approach (FCA).
WV Division of Forestry http://www.wvforestry.com/	• Oversees the Managed Timberland Program to provide tax incentives for landowners who manage their forest land sustainably according to a management plan • Oversee timber sales and Best Management Practices • Provides training workshops for loggers on safety and Best Management Practices • Maintains list of consulting foresters who can help landowners with Forest Stewardship Plans to enhance wildlife habitat • Assists watershed groups and other partners on riparian planting in the Chesapeake Bay watershed • Protection of large private forest tracts through Forest Legacy Program
WV Department of Health and Human Resources (WVDHHR) On-Site Sewage Program https://www.wvdhhr.org/phs/sewage/index.asp	• Provides rule interpretation and technical assistance on conventional and non-conventional on-site sewage systems, including information on septic systems, installers, permits, fees and loan programs.

Partner	Role/Assistance Provided
County Planning Commissions • Hardy County Planning Commission http://hardycounty.com/hardy-county-planning-commission • Hampshire County Planning Commission http://planning.hampshirewv.com/ • Morgan County Planning Commission http://morgancountywv.gov/Services/Planning/index.html	• Land use planning to manage floodplains, subdivisions, development, and stormwater
Land Conservation Organizations • Cacapon and Lost River Land Trust https://www.cacapon.org/ • Potomac Conservancy https://potomac.org/ • Land Trust of the Eastern Panhandle https://www.landtrustepwv.org/ • County Farmland Protection Boards http://wvfp.org/ • West Virginia Land Trust https://www.wvlandtrust.org/	• Conservation easements and demonstration projects to protect farms, forests, and riparian areas
The Nature Conservancy https://www.nature.org/en-us/about-us/where-we-work/united-states/west-virginia/	• Assist land conservation organizations with forest and land protection and restoration • Assist landowners with protection and improved management of large forest tracts through conservation easements and forest carbon projects
Trout Unlimited • http://www.wvtu.org/ • http://www.tu.org/	• Restoring brook trout populations in headwaters and tributaries of Patterson Creek and the Cacapon and Lost Rivers. • Plans and implements restoration projects with landowners and in coordination with USFWS Partners program and USDA Natural Resource Conservation Service and Forest Service, and other partners • Provides landowners and partners with technical assistance including permitting, planning, design, construction, monitoring, outreach and education. • Projects focus on riparian corridor and in-stream habitat restoration, invasive weed treatment and aquatic passage barrier removal/replacement to benefit brook trout and other wildlife species

Partner	Role/Assistance Provided
National Wild Turkey Federation (NWTF) https://www.nwtf.org/	• Provides information to landowners on hunting and habitat management for wild turkey and other wildlife • Partners with state and federal agencies on hunting access and habitat management for wild turkey and other wildlife species
Ruffed Grouse Society/American Woodcock Society (RGS) https://ruffedgrousesociety.org/#	• Creates healthy forest habitat for the benefit of ruffed grouse, American woodcock, and other forest wildlife • Works with landowners and government agencies to develop critical habitat using scientific management practices
West Virginia Association for Cave Studies (WVACS) https://www.wvacs.org/	• Contributes to cave surveys and research • Hosts cave scientists and graduate students pursuing cave research at field stations in Greenbrier County
West Virginia Cave Conservancy https://wvcc.net/	• Manages caves to protect sensitive cave resources and environments • Educates and provides expertise to landowners, developers, local governments, and the public on the value of cave and karst resources • Organizes cave and karst conservation projects including sinkhole cleanups and livestock barrier fences. • Preserves access to significant caves through ownership and management agreements • Sponsor research and survey projects on WVCC caves
Cave Conservancy of the Virginias (CCV) https://caveconservancyofvirginia.org/	• Promoting conservation, management, knowledge and acquisition of caves and karst resources in Virginia and West Virginia • Contributes to educational, research and environmental protection projects • Funds a variety of cave and karst education, outreach, research, cleanup, and acquisition projects. • Provides research scholarships and stipends for graduate and undergraduate students • Supports *Project Underground* environmental education program to promote a better understand of caves and karst lands.
Master Naturalists Program http://mnofwv.org/	• Training interested people in the fundamentals of natural history, nature interpretation and teaching. • Instilling an appreciation of the importance of responsible environmental stewardship. • Providing a corps of highly qualified volunteers to assist government agencies, schools, and non-government organizations with research, outdoor recreation development, and environmental education and protection

Appendix 5. Initial Project Plans

Partners met in January 2020 to review the draft Action Plan for this CFA and develop Initial Project Plans for implementation. The following are outlines of the Initial Project Plan for forest, stream and riparian habitats. Initial plans will continue to evolve during implementation of the Action Plan.

Forest Habitats

- **Threat to be addressed:**
  - Forest Health
    - Deer over-herbivory reducing understory re-growth after logging operations
    - Non-native invasive weeds spreading in logged or disturbed land
- **Species and Habitats that will benefit:**
  - Forest species and habitats in general, including early successional and interior habitats
- **Overall Project goals:**
  - Maintain diverse, healthy forest habitat
  - Build awareness and collaboration around
    - proper silvicultural techniques to maintain and improve forest health, especially in areas with high deer populations
    - practices to control deer population and herbivory, and
    - methods to avoid and control non-native invasive weeds
- **Initial activities planned:**
  - Outreach activity in each of 3 counties (Morgan, Hampshire, Hardy) in CFA
- **Actions to be taken:**
  - Encourage that prescriptions for planned timber harvests are designed to generate sufficient understory growth even in areas with heavy deer browse
  - Encourage treatment of non-native invasive weeds as part of forestry operations before and after timber harvests
  - Encourage proper cleaning of forestry equipment prior to forestry operations to reduce the spread of weeds
  - Encourage increased hunting to reduce deer populations, especially around forestry operations
- **Partners involved:**
  - WVU Extension: landowner outreach and workshops
  - WV Forestry Association
  - Women owning Woodlands
  - WV Division of Forestry (instructors, e.g. “meet your forester”)
  - WMAs: demonstration sites
  - WVDNR (technical assistance)

Stream and Riparian Habitats

- **Threat to be addressed:**
  - Sedimentation, stream bank erosion, riparian deforestation
- **Species and Habitats that will benefit:**
  - Target: wood turtles
  - Also benefit: mussels, brook trout, aquatic invertebrates
- **Overall Project goals:**
  - Protect and restore habitat for wood turtle, along with mussels and brook trout
    - Restore instream and riparian buffer habitat
    - Plant riparian buffers, install cattle fencing
- **Actions to be taken:**
  - Initial partner meeting in 2020 to develop timeline and budget
- **Partners involved:**
  - George Washington National Forest
  - USDA NRCS, FSA
  - WVCA, WVDEP
  - USFWS Partners for Fish and Wildlife program
  - Trout Unlimited
  - WVDNR (technical assistance)

Appendix 6. Resources

The following resources may provide additional information to landowners and partners seeking to manage habitat for priority SGCN in this CFA.

West Virginia's Phase 3 Watershed Implementation Plan for the Chesapeake Bay Total Maximum Daily Load (TMDL) http://www.wvca.us/bay/files/bay_documents/1298_WV_WIP3_final_082319.pdf
West Virginia's Chesapeake Bay Program Web resources to restore streams, reduce runoff and improve water quality, focusing on agriculture, urban stormwater, homeowners and forestry. http://www.wvchesapeakebay.us/
Lost River Watershed Based Plan: https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Documents/WP/LostRiver_WBP.pdf
Long Range Plan for Natural Resource Management in the Potomac Valley Conservation District Summarizes natural resources conditions and ranks resource concerns that could be addressed through NRCS technical and financial assistance. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/wv/programs/financial/eqip/?cid=nrcseprd1167606
Living on Karst- A Reference Guide for Landowners in Limestone Regions http://www.livingonkarst.org/living_on_karst.htm
Guidelines for Cave and Karst Protection- IUCN https://www.iucn.org/content/guidelines-cave-and-karst-protection-0
A Guide to Responsible Caving, by the National Speleological Society https://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf
National Wild Turkey Foundation- Landowner's Toolbox https://www.nwtf.org/conservation/category/landownershttps://caves.org/brochure/Guide_to_Resp_Caving_2016.pdf-tool-box

Cerulean Warbler Management Guidelines for Enhancing Breeding Habitat in Appalachian Hardwood Forests http://amjv.org/wp-content/uploads/2018/06/cerulean_guide_1-pg_layout.pdf
Best Management Practices for Golden-winged Warbler Habitats in the Appalachian Region: A Guide for Land Managers and Landowners. http://gwwa.org/resources/GWWA-APPLRegionalGuide_130808_lo-res.pdf
Wildlife Habitat Council Integrated Vegetation Management Project Guidance for Infrastructure Corridors: https://www.wildlifehc.org/wp-content/uploads/2015/11/WHC-Integrated-Vegetation-Management-Project-Guidance.pdf
Brochures about Aquatic Invasive Species, Forest Pests and Pathogens, and Invasive Plant Species https://www.nrcs.usda.gov/wps/portal/nrcs/main/wv/technical/ecoscience/invasive/
American Forest Foundation: Woodland owners planning tool for forest management https://mylandplan.org/
The Nature Conservancy Resilient Land Mapping Tool and Documents: http://maps.tnc.org/resilientland/
USDA Forest Service, Northern Research Station's Climate Change Atlas: documentation of current and possible future distribution of 134 tree species and 147 bird species in the Eastern United States https://www.fs.fed.us/nrs/atlas/
Rudnick, D.A. et al. 2012. The Role of Landscape Connectivity in Planning and Implementing Conservation and Restoration Priorities. Ecological Society of America. https://applcc.org/cooperative/our-organization/rudnick-et-al.-2012-the-role-of-landscape-connectivity-in-planning-and-implementing-conservation-and-restoration-priorities
Adaptation Workbook: A climate change tool for land management and conservation, created by the Northern Institute of Applied Climate Science: https://adaptationworkbook.org/

U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information, and subject matter expertise to build climate resilience. The Toolkit offers information from all across the U.S. federal government in one easy-to-use location. https://toolkit.climate.gov/tool/climate-smart-conservation-putting-adaptation-principles-practice
Forest Adaptation Resources: climate change tools and approaches for land managers, 2nd edition, 2016, published by the USDA Forest Service, Northern Research Station https://www.nrs.fs.fed.us/pubs/52760
Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. U.S. Department of Agriculture. https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf