NEVADA WILDLIFE ACTION PLAN

Developed by the:
Wildlife Action Plan Team

Final

Submitted September 6, 2012

Approved March 1, 2013

Nevada Department of Wildlife
1100 Valley Rd.
Reno, NV 89512

Recommended citation:

Wildlife Action Plan Team. 2012. Nevada Wildlife Action Plan. Nevada Department of Wildlife, Reno.

Wildlife Action Plan Team

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Wildlife Action Plan Revision

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ACKNOWLEDGMENTS

The Nevada Wildlife Action Plan revision is the result of the hard work of numerous partners whose contributions range from technical input to text review, to drafting some portion of the plan. This work was a team effort in every sense. However, special recognition goes to Larry Neel, retired Wildlife Diversity Division Staff Specialist for the Nevada Department of Wildlife, for his role in the delivery of this revised Wildlife Action Plan. Larry's vision, commitment and vast knowledge of the wildlife resources of Nevada are evident throughout the plan. During the development of the plan, Larry had a unique talent for integrating predicted habitats changes into wildlife species response and then developing conservation strategies for threats posed by climate change and other agents of change. The revised Wildlife Action Plan is an innovative, progressive blueprint for wildlife conservation in Nevada, thanks in large part to Larry's efforts.

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EXECUTIVE SUMMARY

Congress passed the State Wildlife Grants program (SWG) in 2001 in recognition of the need for funding of wildlife diversity programs. Congress mandated each state and territory to develop a Comprehensive Wildlife Conservation Strategy (now named Wildlife Action Plans) by 2005 in order to continue to receive federal funds through the SWG program. Nevada's Wildlife Action Plan (WAP) was completed and approved by the U.S. Fish and Wildlife Service (USFWS) in 2005. Nevada's WAP has served as a plan of action for state wildlife conservation and funding by targeting the species of greatest conservation need and the key habitats on which they depend. To date, NDOW has received over $11 million in federal dollars through the SWG program.

NDOW has been coordinating and leading a conservation partner planning team to revise Nevada's Wildlife Action Plan to incorporate the potential impacts of emerging and expanding stressors including climate change, accelerated energy development, invasive species, and disease on Nevada's fish, wildlife, and habitats. NDOW partnered with the original Wildlife Action Plan team: The Nevada Natural Heritage Program, The Lahontan Audubon Society, The Nature Conservancy, and also The Great Basin Bird Observatory to develop this revision to the plan.

Among the 50 states, Nevada ranks eleventh in overall biological diversity and is unfortunately ranked fifth in the number of species extinctions. Nevada's diversity of life is derived from its geography; the many mountain ranges are effectively isolated from one another by arid and treeless basins. Nevada's borders encompass about 71 million acres, making it the seventh largest state. The federal government administers 86% of the land base.

Nevada is uniquely challenged in approaching effective wildlife conservation in part because of its arid climate, geography and limited water resources, which has created a unique endemic biota easily subject to threats and stressors. Throughout Nevada, water is a scarce and valuable resource essential for both human needs and maintenance of wildlife and their habitats, thus the alteration of hydrologic resources is a significant source of stress to wildlife resources. Invasive, exotic and feral species are critical problems facing both terrestrial and aquatic species and habitats in Nevada.

NDOW has been coordinating with state, federal, and local agencies, and conservation organizations to gather pertinent information for the plan revision. Public scoping meetings were held the winter of 2012 in Elko, Las Vegas, and Reno. We have been working with multiple stakeholders to assess key habitats and species most likely to be affected by these stressors and have developed effective strategies for managing and mitigating impacts. By identifying key conservation actions, we will be in a stronger position to ensure ecosystem resiliency across the changing landscape for key habitats and species. A major project theme will be "keeping common species common" through the constant assessment of the status and needs of wildlife and their habitat and the initiation of responsive action before critical thresholds are crossed.

This Nevada Wildlife Action Plan Revision (2012) is organized into 11 major sections:

- Introduction
- An Overview of Nevada
- Approach & Methods
- Nevada's Wildlife Heritage
- Challenges in Wildlife Management
- Identification of Species of Conservation Priority
- Defining Nevada's Landscape for Wildlife
- The Conservation Strategies for Nevada's 22 Key Habitats and Their Associated Wildlife

- Key Partnerships and Implementation Mechanisms
- Conservation Education and Watchable Wildlife
- Species Accounts

The sections are intended to complement each other and work together to describe the overwhelming task of comprehensive wildlife conservation in Nevada, the partners expected to participate in its ultimate achievement, and the expectations and methods of implementation.

With the help of experts from all taxonomic fields, the WAP Team identified a total of 256 Species of Conservation Priority. The various ecological systems of the state were organized into 22 key habitat types. Multi-level strategies were devised for these 22 key habitats that integrate conservation needs for species assemblages as well as individual species. Each strategy describes the habitats, their values to wildlife, land uses within the habitat and problems facing the species and habitats. This information provides support to the goals, objectives and actions that follow. The objectives and actions are derived from existing conservation plans, where available, and feedback from multiple meetings with species experts and conservation partners during the revision of the WAP. Each strategy includes a list of key conservation partners, programs, and projects likely to fulfill the objectives for each key habitat, and identifies preliminary focal areas for action through a process that involved coordination with partners and concurrent planning processes.

As in the 2005 plan, it will be the task of Nevada’s wildlife conservation partnership to evaluate the 22 strategies, set priorities, design implementation plans, monitor progress and evaluate the results. The WAP describes work prioritization and quantifiable objectives, key partnerships and implementation mechanisms, including several proposed examples to achieve successful implementation of the WAP. During implementation of Nevada’s WAP, it is critical to recognize the importance of monitoring success and adjusting priorities and actions (adaptive management).

How to Use this Plan

Use of this Plan

The Nevada Wildlife Action Plan (WAP) serves as a comprehensive, landscape level plan, identifying the species of greatest conservation need and the key habitats on which they depend, with the intent to prevent wildlife species from becoming threatened or endangered. The WAP contains conservation actions to provide guidance to successfully conserve Nevada's key habitats and priority species. Many of the conservation actions within the WAP are strategies identified in other existing conservation plans. The WAP's recommended conservation actions in no way represent a mandate or expectation for a given party to carry out or implement these actions. During WAP implementation, conservation actions developed at the state or local level would be used to provide guidance to address site-specific conditions as appropriate. Some of these actions may be applicable at the land use plan level, and some more appropriately applied at an activity plan or site-specific plan level.

The next step in the ongoing implementation phase will be to tier down possible actions identified in the WAP that will form the basis for prioritized work plans, site-specific decisions, and planned actions. Wildlife conservation partners and stakeholders will be encouraged to contribute to and review these implementation processes.

Guiding Principles

Conservation partners from the Governor's Sage-Grouse Conservation Team convened in May 2005 to develop a set of "guiding principles" for the WAP writing team while preparing the Draft Plan. The guiding principles decided upon included:

- the WAP is a guidance document for enhanced conservation, not a de facto regulatory document
- the WAP will function as a usable document incorporating adaptive management theory
- the WAP is a road map linking existing plans into common effort
- the WAP is primarily focused on the conservation of wildlife
- the WAP operates under a collaborative process
- the WAP recognizes all authorities, jurisdictions, and citizen's rights, including property rights
- the WAP is primarily designed to address the needs of species before they become imperiled through the creation and implementation of incentives, services, and benefits
- Regulation is recognized as a sometimes necessary mechanism when voluntary processes fail; regulation should be developed as an open, collaborative, citizen based process.

These guiding principles continue to hold true in this 2012 revision of the Wildlife Action Plan.

2012 Nevada Wildlife Action Plan Revision Structure

The Nevada Wildlife Action Plan Revision (2012) is organized into 11 major sections that are intended to complement each other and work together to describe the overwhelming task of comprehensive wildlife conservation in Nevada, the partners expected to participate in its ultimate achievement, and the expectations and methods of implementation.

- **Introduction** describes the purpose and intent of the WAP, its legislative mandate, and the major guidance provided by Congress.

- **An Overview of Nevada** describes the nature of Nevada's ecological setting, its socioeconomic history, and the land ownership mosaic.

- **Approach & Methods** describes the methodologies that were utilized during the analyses of species of conservation priority, key habitats, climate change effects on wildlife, and developing conservation strategies.

- **Nevada's Wildlife Heritage** describes the state's current wildlife resources as influenced by geological and historical processes – why Nevada has the species it has, and why and how species develop conservation risk. The process for determining the Species of Conservation Priority to be featured in this strategy is described in general terms in this section, with a detailed description of the species prioritization processes used occurring in Appendix D.

- **Challenges in Wildlife Management** describes the issues influencing wildlife conservation, anthroprogenic, and natural in origin. Issues ranging from climate change to invasive species to development are discussed.

- **Identification of Species of Conservation Priority** describes the methodologies that we utilized during the analysis of species of conservation priority. The process for determining the Species of Conservation Priority to be featured in this strategy is described in general terms in this section, with a detailed description of the species prioritization processes used occurring in Appendix D.

- **Defining Nevada's Landscape for Wildlife** discusses the development of the ecological framework for strategy development. Here, the reader can find the process for developing the 22 Key Habitats from Southwest ReGAP habitat type inventory to provide the basic strategy units (the Key Habitats), the process by which we linked Species of Conservation Priority to the 22 Key Habitats to interlock species conservation strategy development with habitat types, and the process by which we identified potential focus areas where conservation strategy for the species and key habitats was likely to be applied. In addition, the reader will find the various landscape scale conservation-based efforts, initiatives, and/or cooperatives that have been developed in recent years to streamline land management efforts throughout Nevada.

- **The Conservation Strategies for Nevada's 22 Key Habitats and Their Associated Wildlife** provides the main description of the conservation task at hand in Nevada. Here the reader will find descriptions of the 22 major habitat groups that occur in the state along with each key habitat's particular importance to wildlife, each key habitat's associated Species of Conservation Priority organized by the important features of the habitat type that most influence the presence of the species ("key habitat elements important to wildlife"). Included in this section are the predicted effects of climate change and wildlife responses to those effects, each key habitat's current condition, current land uses, and current problems in meeting its full contribution to statewide comprehensive wildlife conservation. A Conservation Strategy has been designed for each key habitat, consisting of goals written in terms of desired landscape conditions, directional objectives (increase, decrease, maintain) that are measurable with respect to their overall trend by the end of the planning period, and suggested management actions that could significantly contribute toward the movement of the objectives into the desired direction. While most management actions are habitat-based, working under the assumption that the most effective method for maintaining healthy, diverse wildlife populations is through responsible habitat management, some management actions are non-habitat-based and refer to a single species or sometimes groups of species. While species-based actions could occur across a variety of habitat types, we attempted to present actions in the habitat type that is key to their implementation to avoid redundancy in the text.

- The **Key Partnerships and Implementation Mechanisms** section describes how the conservation strategies from the Key Habitats section will be prioritized, compiled, and integrated into the appropriate planning processes, distributed for local working group implementation, monitored for effectiveness, collectively analyzed and adjusted to meet new perceptions of need. Methods of partnership development of WAP services and products and partnership guidance of overall implementation are discussed in this section.

- The **Conservation Education and Watchable Wildlife** section describes Wildlife Education objectives, Watchable Wildlife objectives, and also implementation mechanisms and effectiveness methodologies for Conservation Education in the WAP.

- For readers with a species-based focus, we have provided a separate section of **Species Accounts** that not only provide status, distribution, and natural history information for each Species of Conservation Priority, but also attempt to capture the conservation strategies from the Key Habitat discussions relevant to a particular species and consolidate them in one place for quick review.

INTRODUCTION

Purpose and Scope of the Nevada Wildlife Action Plan

The Nevada Department of Wildlife (NDOW) was charged with the development of a statewide Comprehensive Wildlife Conservation Plan, now called Nevada's Wildlife Action Plan (WAP). This planning process was required of each state to continue to receive federal funds through the State Wildlife Grants program. Nevada's original Wildlife Action Plan was completed and approved by the U.S. Fish and Wildlife Service (USFWS) in December, 2005. To date, NDOW has received over $11 million in federal dollars through the State Wildlife Grants program.

NDOW has been coordinating and leading a conservation partner planning team to revise Nevada's WAP to incorporate the potential impacts of emerging and expanding stressors including climate change, accelerated energy development, and invasive species on Nevada's fish, wildlife, and habitats. NDOW partnered with the original Wildlife Action Plan team: The Nevada Natural Heritage Program, The Lahontan Audubon Society, The Nature Conservancy, and also The Great Basin Bird Observatory to develop this revision to the plan. This partnership team was awarded a State Lands Question 1 Bond Habitat Conservation Planning grant in order to help fund these efforts.

We have been working with multiple stakeholders to assess key habitats and species most likely to be affected by these stressors and are developing effective strategies for managing and mitigating impacts. By identifying key conservation actions, we will be in a stronger position to ensure ecosystem resiliency across the changing landscape for key habitats and species. The benefit will be healthy and diverse wildlife populations across the state of Nevada. Primary focus will center on proactively preventing species from being listed as threatened or endangered as well as the restoration of species already listed. A major project theme will be "keeping common species common" through the constant assessment of the status and needs of wildlife and their habitat and the initiation of responsive action before critical thresholds are crossed.

The Original Eight Required Elements Addressed in the Nevada Wildlife Action Plan

This WAP sets a strategic vision for wildlife conservation in Nevada. To further clarify the vision, Congress requires addressing these eight elements in the WAP:

1. Information about wildlife species numbers and distribution,
2. Descriptions of key habitats and locations,
3. Descriptions of problems that may affect identified species and research needed to improve the situations,
4. Descriptions of proposed actions for conservation of the identified wildlife and their habitats,
5. Descriptions of how the species and results of the actions will be monitored,
6. Descriptions of how the strategy will be reviewed and updated on a periodic basis,
7. Coordination with federal, state, local agencies and Indian tribes if the plan impacts land managed by these groups, and,
8. Public participation to identify their priorities.

In 2009, the Association of Fish & Wildlife Agencies (AFWA) and U.S. Fish & Wildlife Service produced a series of guidelines for the states and territories with recommendations on how to incorporate climate change during a major revision of the Wildlife Action Plan. All revisions must continue to address the required eight elements as mandated by Congress, hence the guidance document, "*Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans"* (Appendix A). The recommendations on how to incorporate climate change under each required element in this document provided important guidance to the revision of Nevada's Wildlife Action Plan. The Wildlife Action Plan Team also reviewed the "*Preliminary Draft State Wildlife Action Plan Best Practice*s" document being developed by the AFWA Teaming with Wildlife Committee State Wildlife Action Plan Best Practices Working Group, and have incorporated many of the proposed best practices into this plan revision.

NDOW and the Revision Team have been coordinating with state, federal, and local agencies, and conservation organizations to gather pertinent information for the plan revision. An overview of the revision process was provided to the Board of Wildlife Commissioners in December 2011. Public scoping meetings were held the winter of 2012 in Elko, Las Vegas, and Reno. The revised plan is expected to be completed and submitted to the USFWS for approval by summer of 2012.

AN OVERVIEW OF NEVADA

Physical and Natural Setting

Biophysical Regions and Major Habitat Types

Although Nevada is defined on the map by its political boundary, its interconnected landscapes are a subset of four ecoregions of the western United States. Ecoregions are based on biotic and environmental factors that include climate, physiography, water, soils, air, hydrology, and potential natural vegetation communities (Bailey, 1995). Dinerstein et al. (2000) defined ecoregions as "relatively large areas of land and water that contain geographically distinct assemblages of natural communities." The four ecoregions that overlap Nevada include the Columbia Plateau, Great Basin, Sierra Nevada, and Mojave Desert.

The Columbia Plateau is a broad expanse of sagebrush-covered volcanic plains and valleys in the semi-arid Intermountain West that is crossed by the large riverine systems of the Columbia, Snake, Boise, and Owyhee. The ecoregion covers over 301,000 square kilometers (116,220 square miles) of land – of which 97% is located in Oregon, Idaho, Washington, and Nevada, and the remainder in California, Utah, and Wyoming.

The Columbia Plateau is bordered to the south by the Great Basin ecoregion which encompasses more than 29,137,365 hectares (72 million acres) of semidesert from the east slope of the Sierra Nevada across much of Nevada to the Wasatch Mountains of the western Rocky Mountains in central Utah. Nevada is the most mountainous state in the U.S. with over 300 mountain ranges separated by long, broad valleys. The Great Basin is characterized by salt desert scrub and sagebrush shrublands in the valleys and the lower slopes, and by piñon-juniper woodlands, mountain sagebrush, open conifer forests, and alpine areas in the mountain ranges. Remote mountain tops, isolated aquatic habitats in valley bottoms, weathered badlands, and sand dunes highlight the Great Basin's unique biological diversity.

Desert slopes on the east side of the Sierra Nevada ecoregion partially descend upon Nevada along the western Great Basin border. Vegetation in this part of the ecoregion is characterized by conifer communities mixed with sagebrush and piñon-juniper in the lower elevations and an alpine zone characterized by bare rock, permanent snow fields, and a few grass or forb species.

Finally, the Mojave Desert characterizes much of southern Nevada. The Mojave Desert extends from southwestern Utah to southeastern California over to western and northwestern Arizona. Creosote scrub, succulents, and yucca-blackbrush community types dominate the ecoregion. Upper elevation community types, atypical of a desert ecoregion, do occur in the sky island mountains and mountain ranges of the Mojave Desert which contain some of the ecoregion's most isolated communities and species.

Climate

Nevada contains portions of two great deserts, the Great Basin Desert and the northern extent of the Mojave Desert. The Great Basin Desert is a cold desert; the Mojave is the smallest of America's hot deserts. These two physiographic provinces dominate the Nevada landscape. While the Sierra Nevada barely make a physical incursion into Nevada, its physical presence dominates the entire state by dictating rainfall patterns and vegetation patterns, which in turn strongly influence the distribution of wildlife in the state. The Sierra Nevada reaches an elevation of 4,265 m (14,000 ft). Rising in a relatively short distance from the Pacific Ocean, the principal source of moisture for the region, the mountains force westward-moving and moisture-laden air masses upward at a dramatic rate. The rising air masses cool, water condenses and forms droplets, and then precipitates as either snow or rain. Thus, the Sierra Nevada effectively rake the moisture out of storm fronts, collecting the moisture on their own granitic shoulders and growing impressive forests of fir, pine, and cedar. The rain shadow created by the Sierra Nevada is recognizable across the state, but is most pronounced in a belt from Tonopah to Lovelock (Trimble, 1989).

Average annual precipitation in Nevada is 23 cm (9 inches), making it the driest state in the nation. Precipitation falls primarily as snow in the Great Basin and Columbia Plateau and as rain in the Mojave Desert, one of the principal factors distinguishing these two regions. The Mojave region is also far more likely to receive summer rains as it lies at the northern limit of the region of the American Southwest that consistently receives monsoonal rains generated from weather systems originating in the Gulf of Mexico. Within Nevada's Great Basin, only White Pine County receives about a month's worth of monsoonal weather (Trimble, 1989).

The average precipitation figure is misleading in that it masks a tremendous amount of variation across the state. The climate of the Great Basin-Mojave Desert region is one of the most varied and extreme in the world (Hidy and Klieforth, 1990). Individual mountain ranges can lift air masses, wringing out whatever moisture escaped the Sierra Nevada and creating precipitation at higher elevations. This local orographic effect creates a rainfall gradient, with mountains receiving noticeably more precipitation than adjacent basins.

Much of the precipitation that falls in the Great Basin arrives outside of the growing season, a problem that vexed settlers and established an evolutionary challenge for plants. Because snowfall occurs outside of the growing season, Great Basin plants must rely largely on water stored in the soil as snow melts. Summer rains in the state are often gully-washers, brief torrents that run off before much moisture can soak into the soil and benefit plants.

While winters in the Great Basin are cold, summers are conversely hot and dry. A temperature range between winter lows and summer highs of 150 degrees has been recorded in Elko (Trimble, 1989). A temperature swing of 40 degrees in any given summer day is not unusual. In the hot, dry, and usually cloudless summers, evaporation far exceeds precipitation. For example, at Pyramid Lake, evaporation exceeds precipitation by a factor of eight. Water evaporates from the surface of Lake Mead, in the Mojave Desert outside of Las Vegas, at the rate of 2.25 m (88 inches) per year–well above the 0.10 m (4 inches) of rain that falls in an average year in that region of the state.

The Mojave Desert is hotter and drier than the Great Basin. Precipitation here falls more typically as rain, though even more unpredictably than in the Great Basin, and it is just as likely to fall torrentially and run off rapidly. There is also considerable variation in the Mojave region. As with the Great Basin, higher ranges receive more precipitation, and the Spring Mountains outside of Las Vegas are often cloaked in snow during winter months–reliably enough to sustain a small ski resort.

Both the form and timing of precipitation in the Mojave, coupled with warmer temperatures, sustains its markedly different natural communities. Across the state, cold winters, hot summers, and scant and unpredictable rainfall have required a variety of adaptations on behalf of animals in order to survive in Nevada's environment. These climatic forces, along with the influences of geography, have created a fascinating array of wildlife in an often harsh and beautiful setting of North America.

Geology

With 314 mountain ranges, Nevada's dominant topographic feature is its basin and range topography. Many writers, including John McPhee (1980), have found poetry in the rhythm of this landscape:

> *Each range here is like a warship standing on its own, and the Great Basin is an ocean of loose sediment with these mountain ranges standing in it as if they were members of a fleet without precedent, assembled at Guam to assault Japan. Some of the ranges are forty miles long, others a hundred, a hundred and fifty. They point generally north. The basins that separate them–ten and fifteen miles wide–will run on for fifty, a hundred, two hundred and fifty miles with lone, daisy-petalled windmills standing over sage and wild rye.*

The mountains of the Great Basin are geologically recent–less than 17 million years old–and a product of crustal stretching between the Sierra Nevada to the west and the Wasatch Range of the Rocky Mountains to the east (Wuerthner, 1992). In the intervening millennia, erosion has steadily chipped away at the higher elevations, filling the basins between the ranges with rock and sediment that typically are thousands of meters thick and, in some valleys, more than 6,100 m (20,000 ft) thick. Crustal stretching and faulting are not uniform, and extensive sections of northwestern and southern Nevada are lower than the central part of the state. These regional differences in elevation, on the order of thousands of feet, have strongly influenced the flora and fauna communities that now occupy these areas.

While the mechanism of this mountain building is consistent across the Great Basin, the underlying bedrock and the resulting composition of the mountains vary. Many granite ranges occur in the west, basalt ranges in the northwest, rhyolite mountains in the center, and limestone and sandstone in the east and southwest (Stewart, 1980). In general, then, the bedrock in the west and in a central band across the state is igneous in origin, and most of the rest of the state's bedrock is sedimentary in origin (Fiero, 1986). A small fraction of Nevada's bedrock is metamorphic. This variation in bedrock likewise produces variations in soils, which in turn influence plant communities and ultimately, faunal communities.

The area, that is now the state of Nevada, experienced other past forces that shaped the geological landscape. Several periods of volcanic activity deposited extensive lava flows and ash. The Owyhee Uplands of the Columbia Plateau in northern Nevada are one of the landscapes shaped by this activity. The presence of the landform is significant because that high plateau country drains north into the Owyhee River, and from there into the Snake River. Scattered across the state is evidence of calderas, lava flows, tuff or welded ash, and other reminders of the land's genesis in molten rock.

At various times in its geologic history, extensive parts of the state have either been ocean or lake front property. Until half a billion years ago, most of Nevada did not exist and instead an ocean stretched westward from what was the edge of the North American continent. A broad carbonate reef began to form along the margin of the continent, extending west into the ocean. In a series of events over the next 300 million years, tectonic plates collided with the edge of the continent and progressively added land mass to western North America. At first, oceans receded during the collisions and then advanced, but oceanic sedimentation finally ceased about 200 million years ago.

More recently, Pleistocene Lake Lahontan was the largest of several primarily freshwater lakes that covered significant parts of the state. All of these events–whether marine or freshwater in origin–were extensive enough and sustained long enough to leave sedimentary deposits that are now visible in various parts of the state. Remnants of Lake Lahontan's presence can also be seen in shoreline terraces, now parched and high above valley floors and supporting desert shrubs instead of bulrushes and sedges. The limestones that formed beneath the oceans now form a major regional aquifer beneath much of northeaster, eastern, and southeastern Nevada, and springs flowing from this aquifer are important water sources for plants and animals.

Also during the Pleistocene and related to the formation of Lake Lahontan, Nevada experienced periods of glaciation that altered several mountain landscapes. Over millennia, the shear mass of glaciers, aided by the abrasive quality of rocks and debris entrained in their ice, acts to erode the bedrock beneath them. When the glaciers retreated, they left behind cirques in their headwaters and classic U-shaped valleys that reveal the paths of the ice masses. These distinctive landscapes are evident in the Sierra Nevada, but also in other mountains, including the Ruby, Humboldt, and Snake Ranges. Other Nevada ranges with evidence of glaciation include the Spring Mountains, Toiyabe Range, Carson Range, Toquima Range, Jarbidge Mountains, Santa Rosa Range, Independence Mountains, and the Schell Creek Range (Wuerthner, 1992).

The high Sierra Nevada range, which only began its rapid rise 3-5 million years ago, efficiently strips water from east-moving storms and creates the pronounced rain shadow that has produced the characteristically dry climate in Nevada. Yet, to a visitor surveying this arid landscape, it may come as a surprise that water is the dominant force shaping the land. By watching an arroyo following a downpour as it disgorges a viscous sludge that is half earth and half water, one receives an effective demonstration of the power of water to episodically but rapidly shape the landscape.

Unique geological conditions, usually in the form of soils, occur in isolated pockets scattered across the state. These conditions have given rise to regionally adapted plants and, at least in some locations, unique species of invertebrates with extremely restricted ranges. There are two conditions which have supported these unique plant-invertebrate associations. Edaphic communities are, by definition, determined by soil conditions. One example of this is the 140 patches of altered andesite scattered across the west-central Great Basin (Billings, 1950, 1990; DeLucia et al., 1988; all in Brussard et al., 1998). These sites, in contrast to the surrounding sagebrush-dominated landscape, are characterized by the presence of Jeffrey or ponderosa pine, and many of them harbor an endemic species of buckwheat. Another example is the gypsum-derived soils of the Mojave Desert in southern Nevada that support endemic plant communities adapted to this soil type. Some of these plants, such as the Las Vegas bearpoppy, are associated with endemic species of bees.

Another specialized soil condition occurs in the network of Holocene era sand dunes scattered across the state. Extraordinary specialization and speciation has occurred in plants and animals at many of these 32 sites. Beetles are the best studied invertebrate group in Nevada's sand dunes, and many new species have been described from these locales. Butterflies, crickets, and a species of weevil are also unique to these habitats. Many of these species are highly endemic and confined to one or a few small dunes (Brussard et al., 1998). As a whole, the invertebrates of Nevada are poorly studied and it is likely that the occurrence of endemism is far more widespread in these groups than is currently documented.

Fish and Wildlife Resources

Among the 50 states, Nevada ranks eleventh in overall biological diversity (Stein, 2002). Unfortunately, the state follows only Hawaii and California in terms of threats to its species, and Nevada is ranked fifth in the number of species extinctions. From a biological point of view, the Great Basin and Mojave Deserts are landscapes of enormous subtlety. The vast and apparently monotonous expanses of sagebrush actually represent a dozen different species, and many more subspecies. Most of the animals accomplished at life in these deserts are colored to blend in with the rocks and vegetation to avoid detection in a land that holds few hiding places. Explorer John C. Frémont declared the region to be "deserving the full examination of a thorough exploration." Nevada does not reveal its nuances to a car traveling 70 miles per hour across Highway 50.

Nevada's tremendous diversity of life is derived from its geography. The many mountain ranges with winter snow pack, trees, meadows, and tumbling streams are effectively isolated from one another by the arid and treeless basins. This juxtaposition of landscapes has effectively created isolated islands of habitat, dubbed sky islands. For the less mobile species of small mammals, reptiles, and some insects, populations have likewise become isolated from one another on these montane islands. Over time, this isolation has led to the evolution of new subspecies and species.

The principles of island biogeography explain other aspects of the state's diversity and the pattern of species across the landscape. Two of the tenets of this branch of ecology state that the number of species on an island will decrease with distance from the mainland (the source of species to populate the island); and the smaller the island, the fewer species the island can sustain. The "mainlands" for the Great Basin province are the Sierra Nevada and the Rocky Mountains. Moving eastward from the tree-rich Sierra Nevada, the number of tree species declines until, in Central Nevada, ranges such as the Toiyabes and Monitors harbor only a few species (Wuerthner, 1992). A similar pattern occurs in Eastern Nevada, where, moving through ranges from east to west, the trees decline in both diversity and in their affinity with the Rocky Mountains. A similar pattern has been documented in mammal populations in Nevada.

While mobile species like birds might be expected to be unaffected by the effects of distance and island size, such is not the case. The reduced number of plant species in the interior mountain ranges translates to lower habitat diversity, which in turn, offers fewer niches for birds to occupy, and thus fewer species overall.

One other characteristic of the Nevada landscape and subsequently its wildlife worth noting is that, resources, principally food and water, occur in abundance in only a few noteworthy places. Across the remainder of the state, such resources are widely scattered at a low density. The distribution of wildlife tends to reflect the distribution of food and water resources, and therefore with few exceptions, wildlife species are not found in high densities within their Nevada ranges. This factor does not reduce the value of wildlife to the health of the natural environment, or the value it brings aesthetically or economically to the state.

With the exception of the Colorado River along the southeastern border of the state and a few tributaries of the Snake River in the north, all of Nevada's watersheds are isolated systems (Wuerthner, 1992). In general, they originate at springs on the flanks of mountains, descend through desert shrubs, and vanish into sinks and playas. Accordingly, the pattern of isolation and divergence has been even more extreme for Nevada's aquatic species. During the Pleistocene, this region of the globe was considerably wetter than it is today, and lakes covered significant parts of the state. As the Pleistocene waned and the Earth entered a drier, warmer period, the lakes receded and vanished, sometimes completely, sometimes leaving behind only isolated wetlands and remnant springs. Organisms, such as springsnails (pyrgs) and pupfish that once resided in enormous lakes now persist in tiny seeps and springs, each population cut off from its nearest neighbor, often by miles of desert. Over time, these populations have evolved into species, each uniquely adapted to their tiny corner of the world.

Nevada has 46 endemic species of fishes – species occurring nowhere else in the world. With the human reliance on water, nearly all rivers, springs and aquifers are tapped and at some point dewatered, and this natural competition for water has left the state with more endangered fish species than any other state (Wuerthner, 1992). At least seven Nevada fish species are known to have become extinct, while four other species no longer occur in Nevada although other populations persist beyond the state borders.

One famous example of endemism occurs in southern Nevada, not far from the California border and Death Valley. Devil's Hole is a spring perched on a desolate ledge of black rock, creosote, and cactus. The spring itself is actually at the bottom of a hole, a defile in the rock, wherein resides the world's entire natural population of the Devil's Hole pupfish. Below Devils Hole and 20,000 years ago, a lake once covered the Amargosa Valley floor, and the pupfish swam freely through hundreds of square miles of water. Now, their entire population is confined to a crack in the bedrock, amidst some of the most inhospitable desert found anywhere. This is one of the state's nuances, and a profound experience for those who visit Devil's Hole.

Land and Resource Management

Nevada's borders encompass about 28,732,680 hectares (71 million acres), making it the seventh largest state. The federal government manages approximately 24,685,825 hectares (61 million acres), or 86% of the land base. Of the remaining 14% (approximately 4,046,855 hectares; 10 million acres), 11.5% is private, 1.6 percent tribal, and the remaining 0.8 percent is under state or local government ownership. On a percentage basis, Nevada has more federal land than any other state in the Lower 48. Land status is illustrated in Figure 1. At least 90% of the land in Esmeralda, Lander, Lincoln, Nye, and White Pine counties is federally managed, while overall, 50% or more of the land in each county is federally managed, except the two smallest counties (i.e., Storey and Carson City).

The majority of BLM and USFS land in Nevada is managed under multiple use and sustained yield policies mandated by federal statutes. Multiple uses requires federal agencies to manage the public lands and natural resources for a combination of diverse uses while balancing long-term needs for renewable and non-renewable resources. The BLM and USFS manage multiple use lands for grazing, mining, outdoor recreation, scientific study, and ecological function. Resources currently receiving considerable attention in USFS Forest Plans, BLM Resource Management Plans and Regional Ecological Assessments include wetland and riparian resources, wild horses, biological diversity, forage production, forest health, watershed conditions, wildlife habitat, motorized recreation, and noxious and invasive weeds.

The Bureau of Reclamation has jurisdiction over a large area of the Great Basin and a smaller portion in the Mojave within Nevada. The main area of BOR activities is in the Colorado, Walker, Carson, Truckee, and Humboldt River basins, where there are five operating Reclamation projects and one resource management project.

State land management agencies are similarly mandated to manage resources according to multiple use and sustained yield principles, as defined by state law. State lands include 11 wildlife management areas, 24 state parks, and 500 parcels (91 hectares; 225 acres) of other state lands. There are approximately 3,237,485 hectares (8 million acres) of private land in Nevada. Land uses of private lands are predominantly urban and suburban development and agriculture.

Nevada Stewardship Map

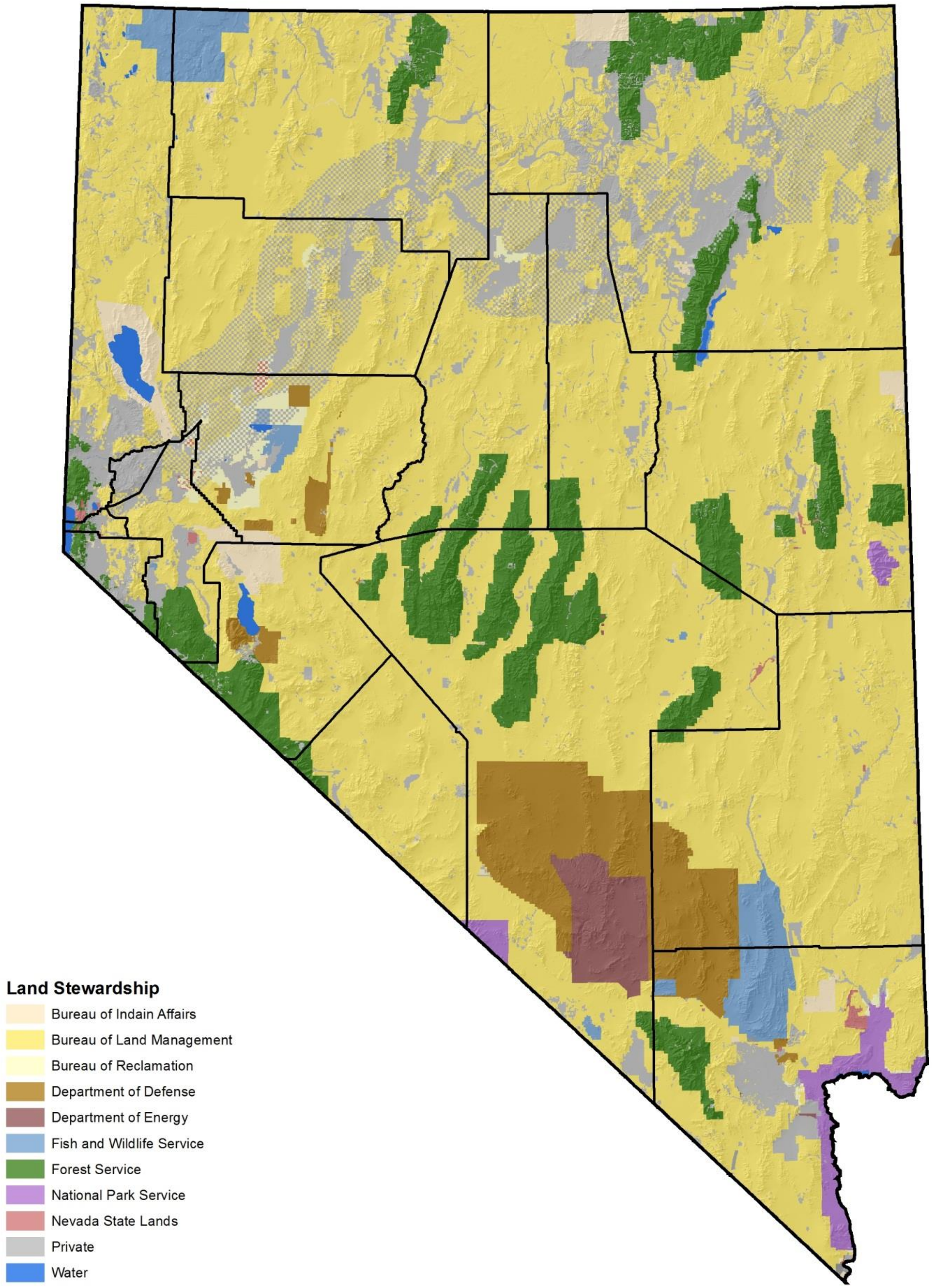


Figure 1. Map of Nevada indicating land ownership/land management patterns.

Human Demographics and Impacts

Up until 2009, Nevada was the fastest growing state in the nation, with three of its most populous cities in the top 20 for growth nationwide. Based on the 2010 U.S. Census study, Nevada experienced a 35% population increase statewide (U.S. Census Bureau, 2010). More specifically, Clark County underwent a 47% population increase (U.S. Census Bureau, 2010) between 2000 and 2010 which also brought about increased infrastructure (roads), housing developments, power lines, and shopping centers, often in areas where wildlife once roamed. Nevada is the most urbanized state in the nation, with nearly ¾ of its 2.7 million human population associated with the cities of Las Vegas, Henderson, and Reno.

Even the once-remote rural areas of the state are impacted by population growth. One of the greatest population increases within the state occurred within Lyon County with a 51% countywide increase, particularly in the rural communities of Fernley, Dayton, and Yerington (U.S. Census Bureau, 2010). Rural communities strain to keep up with the influx of urban dwellers fleeing the cities; out-of-state manufacturers moving into a low tax environment; and energy developers pursuing new technology or areas to develop new resources.

Survey data reported as part of Colorado State University's "Wildlife Values in the West 2004" (Teel and Dayer, 2005) survey project provides a baseline for residents' attitudes about wildlife and threatened species. The survey of 633 residents identified 15 activities that Nevada Department of Wildlife may focus on in the coming years, and asked participants to rank their level of importance. "Protecting fish and wildlife in Nevada that are endangered or at risk of becoming endangered," ranked third overall, after apprehension of wildlife violators (first priority) and promotion of boating safety (second priority). In a survey question where agency fiscal constraints were identified as a limiting factor, and participants were asked to identify which 3 of the 15 activities should be chosen, "Protecting fish and wildlife in Nevada that are endangered or at risk of becoming endangered," rose to the top, with 197 respondents supporting this activity as one of their top three priorities.

In that same survey question, it is worthy to note that the second and third priorities overall were for "Managing for adequate populations of all fish and wildlife in Nevada," (second priority) and "Protecting, restoring or acquiring lands to support many different types of fish and wildlife," (third priority). From these responses, it is clear that not only do Nevadans feel strongly about managing all fish and wildlife species, but that they understand that protection and restoration of lands is an essential part of this process.

APPROACH & METHODS:
Overview

Organizational Structure

Nevada Department of Wildlife identified its Wildlife Action Plan Development Team in August, 2004 through the application for a conservation planning grant from the State of Nevada's Question One Conservation Bond and Resource Protection Grant Program. The partnership to develop the Nevada WAP included The Nature Conservancy's Nevada Chapter, the Lahontan Audubon Society, and the Nevada Natural Heritage Program. The Q1 grant was awarded by Nevada Division of State Lands in October, 2004, and the team commenced work on the deliverables for Phase I of the WAP. The primary objective of Phase I was assembling Nevada's WAP.

Phase II began immediately after Plan approval and focused on implementation of the WAP. Some key achievements of the Nevada Wildlife Action Plan Team that "stepped down" from the WAP included the completion of the Nevada Wetland Priority Conservation Plan led by The Nevada Natural Heritage Program, the completion of the Steptoe Valley Conservation Action Plan, a project led by The Nature Conservancy to demonstrate techniques for stepping down Wildlife Action Planning to local scales, and the revision of Nevada's Partners In Flight Conservation Plan (now the Nevada Comprehensive Bird Conservation Plan) led by Great Basin Bird Observatory. Other stepdown planning efforts included the Springs Conservation Plan, a collaborative effort between Nevada Natural Heritage Program and The Nature Conservancy, and a county-planning/WAP integration project led by Nevada Audubon. All these stepdown planning projects were funded by Question One grants.

The Climate Change Challenge

In anticipation of major climate change policy and funding emanating from Congress, in early 2008, the Association of Fish & Wildlife Agencies (AFWA) encouraged states to update their Wildlife Action Plans to address the predicted effects of climate change in their state. Options were suggested to either add a chapter discussing the effects of climate change or to conduct a full revision of their 2005 Plan. The Nevada Team anticipated the effects of climate change to be somewhat dramatic in Nevada to the point that the Species of Conservation Priority list might significantly change as well as the focus on key habitats based on their predicted responses, so Nevada opted for a full revision with climate change analysis pulled through every aspect of analysis and strategy. The "climate change revision" effort was initiated in May 2008 and plans were made to secure another Q1 grant to fund the revision partnership. NDOW also received State Wildlife Grant funds to support agency staff in the revision of this plan. In addition, the Nevada Team reached out to key representatives of the major federal resource management agencies – Bureau of Land Management, U.S. Forest Service, U.S. Fish and Wildlife Service, and Bureau of Reclamation for membership on the team. All four agencies responded with designees. Major elements of the revision process that the Team developed and funded through the Q1 grant are described by header below:

Habitat Analysis

The Nature Conservancy took on the task of predictive modeling of climate change effects on Nevada's vegetative communities. The methodology used by TNC is Landscape Conservation Forecasting™ (formerly Enhanced-Conservation Action Planning; Low et al., 2010), which consists of:

a) maps of potential and current vegetation obtained from remotely-sensed imagery;
b) state-and-transition computer modeling of alternative management scenarios (for example, without and with climate change effects) applied to each ecological system in the mapped landscape; and
c) return-on-investment analysis of ecological improvement relative to the cumulative cost of management actions comparing the different management scenarios and all managed ecological systems.

The Nature Conservancy measured ecological condition using two landscape-scale metrics for each ecological system: ecological departure from the reference condition and the percentage of high-risk vegetation classes. Additionally, TNC provided results of each vegetation class, which was essential to relate changes in vegetation structure and food availability to the needs of wildlife species. The results of Landscape Conservation Forecasting™ applied to each of Nevada's 13 regions were provided to NDOW in the report, "Climate Change Revisions to Nevada's Wildlife Action Plan: Vegetation Mapping and Modeling"; hereinafter, referred to as the "*TNC Climate Change Report*" (Provencher and Anderson, 2011).

Species Vulnerability Analysis

Concurrent with habitat modeling, the Nevada Natural Heritage Program conducted a wildlife species vulnerability analysis using the NatureServe Climate Change Vulnerability Index evaluation program (Young et al. 2011) to determine which wildlife species exhibited characteristics that might uniquely hinder their adaptation to climate change, including but not limited to general mobility, physiological challenges, dependence on certain vegetation types or plant species, etc. Because of cost concerns, the WAP Revision Team made the decision to limit CCVI analysis to the 2005 Species of Conservation Priority list. Methods and results of the Nevada CCVI are presented in Appendix D, Table 1.

After the first draft of the Nevada CCVI was completed, members of the WAP Revision Team conducted intuitive analysis (i.e., expert opinion) of all terrestrial wildlife species *not* on the Species of Conservation Priority list to look for patterns and similarities between non-priority species and priority species that scored above "presumed stable" in the CCVI. Non-priority species that exhibited traits or habitat limitations similar to CCVI species with elevated scores were then run through CCVI analysis and scores were assigned to them for standardization purposes.

Avian Climate Change Response Modeling

The Great Basin Bird Observatory was contracted through the Q1 grant to provide specific data-supported climate change predictions for Nevada's breeding birds using point-count data from the Nevada Bird Count (NBC), a statistically-rigorous 10-year database with georeferencing and coarse-scale habitat association capability. Avian Species of Conservation Priority occurrences in the NBC were geospatially attached to the LANDFIRE map used by TNC to generate the habitats analysis. Results from the TNC analysis were then evaluated regarding potential consequences to Nevada's breeding birds and avian species responses were predicted. The results of the GBBO report are presented in the report "Bird Population Responses to Projected Effects of Climate Change in Nevada: An Analysis for Revision of the Nevada Wildlife Action Plan" (Appendix E).
Another partner group associated with University of California, Davis, the Connectivity Assessment Group, graciously donated another avian climate change analysis to the WAP revision process that evaluated possible patterns of movement on the landscape of priority birds based on the availability and connectivity of suitable habitats as currently understood versus climate change projections in habitat shifts. This analysis was interpreted and presented geospatially and demonstrated more detailed "stepdown" analysis that could be

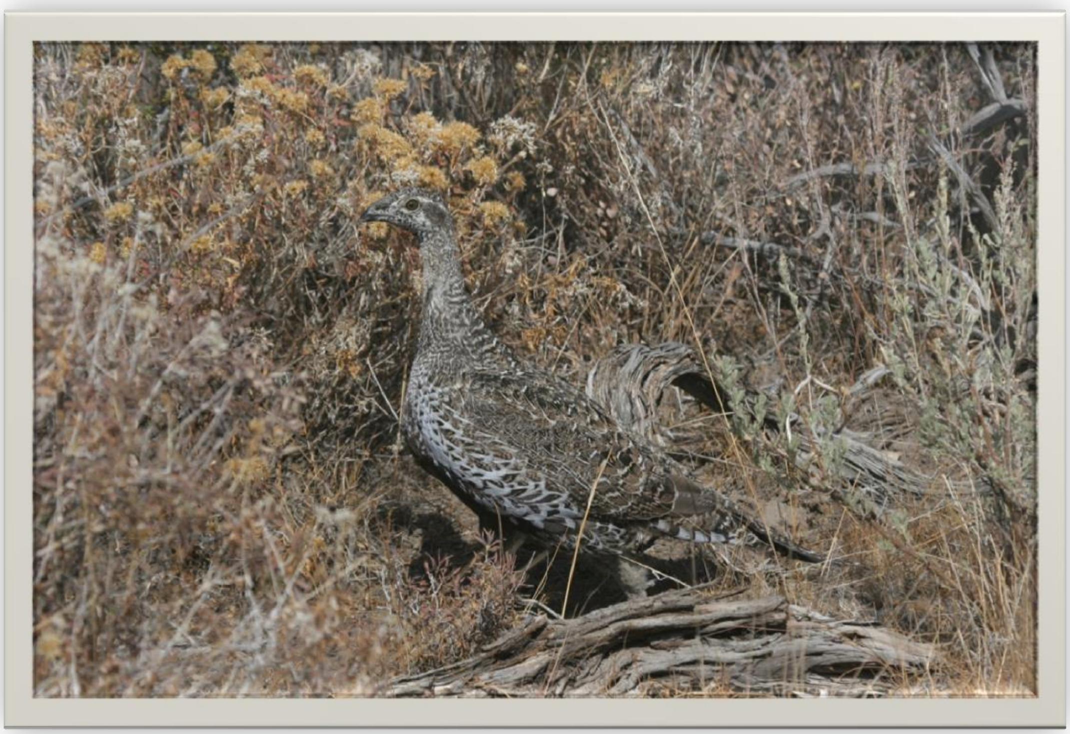
implemented as part of the WAP Adaptive Management framework once the Revision goes into effect. Results from this effort will be presented in the upcoming report "Current and projected future connectivity of habitat for breeding birds in the central Great Basin" (Fleischman et al., *publication pending*).

Pulling It All Together

Once the analytical products were completed, the Revision Team had to fit the results together to ultimately project the future of wildlife on Nevada landscapes over the next 50 years under a changing climate. Seven major tasks were undertaken:

1. Revision of the Species of Conservation Priority List
2. Revision of the ecological framework to fit the new vegetative analysis
3. Analysis of how ecological system changes/shifts were likely to impact living conditions and survival potential for priority species within relevant regional contexts
4. The construction of conservation strategy to maximize the preservation of wildlife diversity within state boundaries
5. Revision of the Focal Area analysis
6. Revision of the Implementation and Adaptive Management Framework
7. Revision of the Wildlife Action Plan itself with meaningful partner/stakeholder participation and review

Each of these tasks and how they were engaged are discussed in the following chapters.



Greater Sage-Grouse Photo Courtesty of A. Gubanich

APPROACH & METHODS:
Revising the Species of Conservation Priority List

The Revision Team started with the Species of Conservation Priority list generated during the 2005 planning process through species risk evaluation tools – one for terrestrial vertebrates, one for fishes and amphibians, and one for mollusks and crustaceans. The Team expressed basic satisfaction in the utility and appropriateness of the 2005 list, and while recognizing that climate change vulnerability had not been strongly evaluated through the 2005 process, opted for an iterative process that fit climate change vulnerability to the existing priority results, rather than go back to the beginning and redesign a completely new tool with climate change vulnerability incorporated in it. For a complete description of the 2005 species prioritization process, please refer to Appendix D.

Once the NNHP Climate Change Vulnerability Index (CCVI) was applied to the 2005 priority species list, a new picture of priority began to emerge, placing much greater concern toward isolated endemic aquatic species with small population sizes, limited mobility and an immitigable dependency on water in nature. Terrestrial vertebrates for the most part exhibited relatively strong adaptability to the nature and degree of climate change being predicted; therefore, a relatively small number of terrestrial vertebrate species ranked at levels of concern more elevated than “presumed stable”. All terrestrial vertebrates run through CCVI receiving scores of “moderately vulnerable,” “highly vulnerable” or “extremely vulnerable” were automatically retained on the revised priority list.

One priority category that had not functioned as planned in the 2005 Plan was the “stewardship species” concept. In order to gain consensus among all stakeholders as well as recognize the tableau of avian conservation planning that had occurred in the previous decade, a “stewardship birds” category was created in the 2005 WAP to note Nevada’s “stewardship responsibility” for birds that had been identified in one of the bird conservation planning efforts (Partners In Flight, U.S. Shorebird Conservation Plan, North American Waterbird Plan) either at the continental or regional scale but which did not otherwise rank as high concern in Nevada. Because the category neither enjoyed full SOCP status nor freedom from concern, most users of the Plan did not know what to do with it. Rather than engender respect and partnership, it mostly just caused confusion. “Stewardship” aquatic species, derived through the application of different criteria, were no more successful. The Revision Team decided to remove the “stewardship” classifications and identify only full-status priority species.

The 2005 Stewardship Bird list was next evaluated for species that should be retained as priorities and those that should be removed. Climate change vulnerability was preliminarily assessed by comparison to species already run through the CCVI. Species similar to birds scoring above “presumed stable” were processed through the CCVI. Species that demonstrated significant population declines in the USGS Breeding Bird Survey results (http://www.mbr-pwrc.usgs.gov/bbs/bbs.html) were also run through the CCVI. The same stepwise evaluation was also performed on all other avian species that were not included on the 2005 list. Since very few birds ranked CCVI scores above “presumed stable”, additions to the list were made based on the severity of decline as reported by USGS, or in the case of species such as Golden Eagle, where specific management issues were anticipated to direct agency priority and resources.

Mammals and reptiles that were not on the 2005 priority list were assigned to the TNC Biophysical Settings (key habitats) as per their known habitat preferences and analyzed as to the predicted cumulative effect of climate change on their preferred habitats. Those species that demonstrated cumulative habitat impacts of an elevated nature were then run through the CCVI. Any mammal or reptile species that scored “moderately vulnerable,” "highly vulnerable" or "extremely vulnerable" were automatically retained on the revised priority list. Some species that scored "presumed stable" were retained for the priority list because of relevant conservation concerns other than climate change.

As with terrestrial species, the "stewardship species" categorization for fishes was found over time to provide little utility and served primarily to create confusion for partners developing conservation planning priorities. Although the initial CCVI analysis provided a basic assessment of potentially changed vulnerabilities for the existing priority aquatic species list, additional CCVI review was also performed on aquatic species identified in the stewardship classification in 2005 and additional lower-tier native fish species which were not priority-ranked in 2005 but were known to occur in aquatic habitats particularly vulnerable to near-term climate change scenarios such as mid- to low-elevation intermontane stream and river systems. This provided the basic analysis to review and update the aquatic priority species lists with primarily the addition of several endemic fishes with a higher vulnerability resulting from new analysis.

Detailed information on the revision of the species of conservation priority list is found in Appendix D.

Greater Sandhill Crane Photo Courtesy of D. Barrett

APPROACH & METHODS:
Defining Nevada's Landscape for Wildlife

The ecological framework for the 2005 Plan was based on Southwest ReGAP (SWReGAP) ecological systems (vegetative communities) and a very simple four-biome representation of the state – Great Basin, Mojave Desert, Columbia Plateau, and Sierra Nevada. The SWReGAP ecological systems were compiled into 27 broader biophysical groups named "key habitats" that approximated major habitat types as they were commonly perceived by Nevada's resource professionals and conservation community – sagebrush, Mojave shrub, pinyon-juniper, cliffs and canyons, etc. – and conservation strategy was developed for each key habitat and presented in the 2005 Plan in the key habitat chapters.

Terrestrial Ecological Framework

The unique challenges of climate change predictive analysis required the Revision Team to shift its primary ecological framework from SWReGAP to LANDFIRE because LANDFIRE has added classification of vegetation into the "characteristic" and "uncharacteristic" types critical to the measure of ecological departure. Specifically, four sources were used to develop new ecological systems now called "**Biophysical Settings**" or **(BpS's):**

1. LANDFIRE (2010a, b, c) is interpreted Landsat satellite imagery, which for each grid cell (pixel) includes: (1) the BpS type; and (2) the succession class or "S-Class" of the BpS type that currently occupies the grid cell. LANDFIRE's Existing Vegetation Cover (EVC) layer represents the average percent cover of existing vegetation for a 30-m grid cell. This layer was used to inform select non-reference classes from the BpS by S-Class layer.

2. Precipitation map from the PRISM (Parameter-elevation Regressions on Independent Slopes Model) group of Oregon State University that shows the distribution of precipitation across the United States based on modeled extrapolation of weather data among weather stations (Daly et al., 2008). PRISM is the USDA's official climatological data. These data were used to a) divide LANDFIRE's Blackbrush BpS between the thermic and mesic BpS's at the 9 inch precipitation zone and b)divide the big sagebrush complex into Wyoming Big Sagebrush semi-desert BpS (8-10 inch precipitation zone), Big Sagebrush-upland BpS (12-14 inch precipitation zone), and the Montane Sagebrush Steppe-mountain BpS (>14 inch precipitation zone).

3. Nevada Natural Heritage Program (NNHP) developed the Annual Grass Index layer, which is the estimated percent ground cover of non-native annual grasses interpreted from two captures of Landsat satellite imagery and field plots (Peterson, 2005). Also, NNHP's layer of known locations of invasive weeds (other than annual grasses) in Nevada served to inform select non-reference classes from the BpS by S-Class layer.

4. Southwestern Regional Gap Analysis Program landcover layer (Lowry et al., 2005) is interpreted satellite imagery of natural and semi-natural vegetation on the landscape. This layer was used to inform select non-reference classes from the BpS by S-Class layer.

The integration of these sources was accomplished by a three-step process:

1. After a review of all LANDFIRE BpS, minor BpS's were merged with larger ones, or ecologically-compatible BpS's that are difficult to separate by remote sensing were combined (e.g., Black-Low sagebrush and Intermountain Basins Semi-desert Shrub Steppe was nested in Mixed Salt Desert);

2. Then both the "concept" and the mapped distributions of all of the major vegetation (BpS) types that appeared in the LANDFIRE source were evaluated; and then

3. A set of queries or decision rules was written as to how those input data were to be depicted, pixel by pixel, on the output of the single merged map. These queries were designed primarily to inform the non-reference classes using the most current on-the-ground spatial information available.

After some final field-informed adjustments, the BpS's used in the TNC climate change analysis were selected. A short description of each vegetation class by BpS used in the analyses is presented in the TNC Climate Change Report and summarized in Appendix C.

The 27 phytogeographic regions layer acquired from NNHP represented floristically and physiographically similar areas of Nevada. This layer was consolidated from 27 to 14 phytogeographic regions to facilitate modeling (Figure 2). The phytogeographic regions were consolidated into the Mojave, Clover-Delamar, Walker Corridor, Eastern Sierra Nevada, Sierra Nevada, Lahontan Basin, Humboldt Ranges, Toiyabe, Eureka, Calcareous Ranges, Elko, Tonopah, Owyhee Desert, and Black Rock Plateau. The Mojave was consolidated from 7 individual phytogeographic regions to one. The Calcareous region was consolidated from three individual phytogeographic regions, and Elko and Tonopah were both consolidated from two phytogeographic regions. Two phytogeographic regions that were not within the boundaries of Nevada were removed.

Table 1. Description of spatial layers used to develop the new Wildlife Action Plan ecological framework.

Spatial Data	***Spatial Resolution***	***Date***	***Creator***
Biophysical Settings	30 m	2010	LANDFIRE
Succession Class	30 m	2010	LANDFIRE
Precipitation	654 m	2006	PRISM
Landcover	30 m	2004	SWReGAP
Annual Grass Index	28.5 m	2004	NNHP
Weeds	Shapefile	2005	NNHP
Existing Vegetation Cover	30 m	2010	LANDFIRE

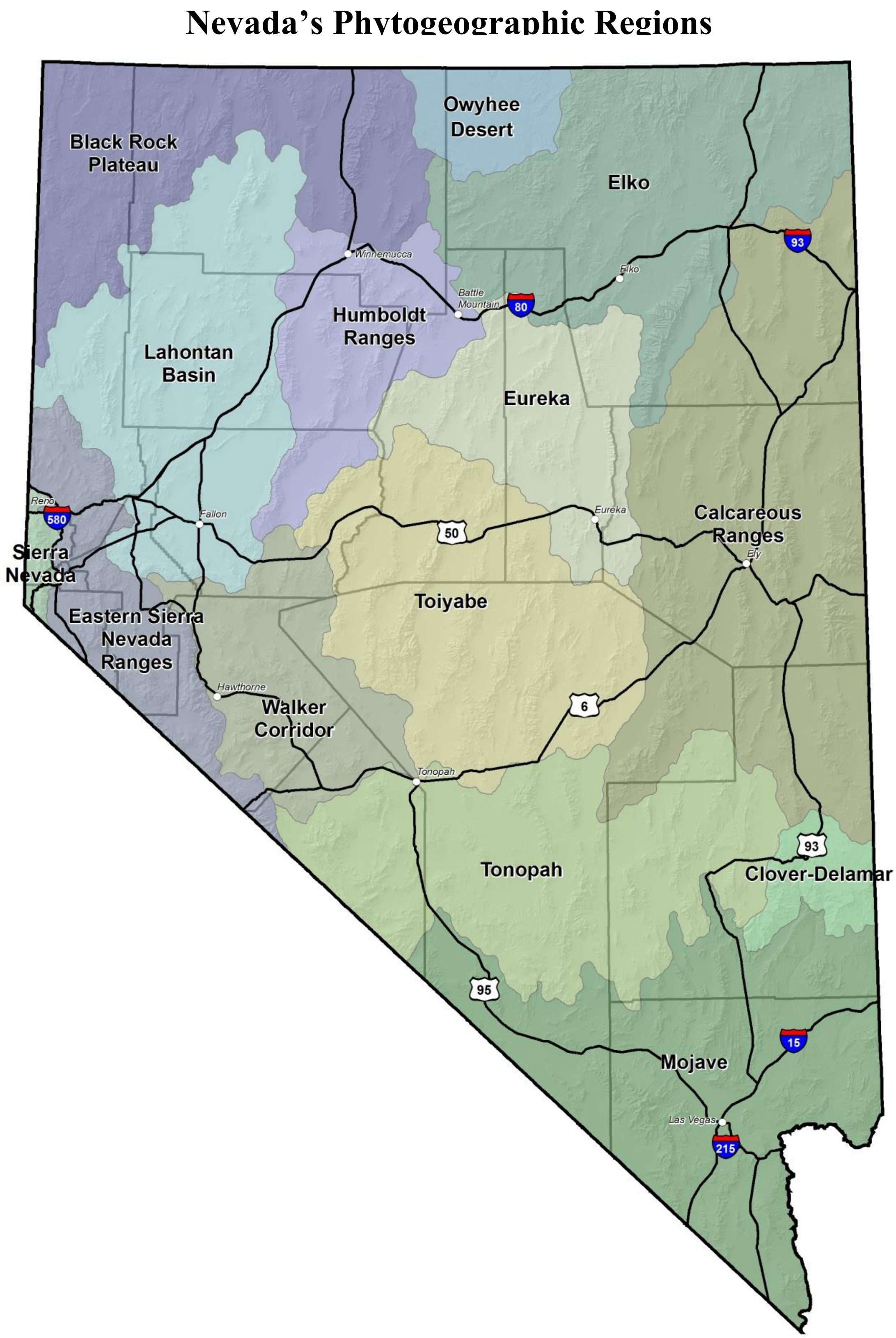


Figure 2. Consolidated phytogeographic regions of Nevada. Based on 27 original regions proposed by the Nevada Natural Heritage Program.

2005 vs. 2012 – Integrating Two Ecological Frameworks

The creation of the TNC phytogeographic regions for climate change analysis created several challenges for the Revision Team regarding the crosswalk between a simple four-ecoregion map with SWReGAP ecological systems to a 14-region map with LANDFIRE BpS's. One problem arose concerning the revision of the Key Habitat acreages reported by ecoregion in each Key Habitat. At the request of federal land management agency Team members, it was decided to continue to report key habitat acreages by the four broad ecoregions from 2005 – Great Basin, Mojave, Columbia Plateau, and Sierra Nevada – which required a clip of LANDFIRE by the four-ecoregion map. A crosswalk between SWReGAP ecological system and LANDFIRE BpS's was also provided for each key habitat chapter.

The revision of ecological systems to biophysical settings necessitated a slight shift in how the key habitats were defined. The 27 key habitats from the 2005 Plan have been reduced to 22 through the following changes:

- Mojave/Sonoran Warm Desert Shrub and Mojave Mid-Elevation Mixed Desert Scrub were combined into one chapter.
- Lower Montane Woodlands and Lower Montane Chaparral were combined into one chapter.
- Intermountain Rivers and Streams, Sierran Rivers and Streams, and Wet Meadows were combined into one chapter.
- Exotic Grasslands and Forblands was eliminated because the vegetative communities were reinterpreted as uncharacteristic classes of many other biophysical settings.

Palmer's Chipmunk Photo Courtesy of C. Klinger

APPROACH & METHODS:
Wildlife Effects Analysis

Integration of Species and Habitat Analysis

The next task was to integrate the species with demonstrated climate change vulnerability to the biophysical settings for the purpose of translating the predicted habitat changes into wildlife species responses. Specific analyses using extensive survey data from the Nevada Bird Count were conducted for birds (see below), but much less habitat-specific data were available for mammals and reptiles, so models were created for them based on general natural history knowledge and expert experience. To the extent possible, we intended to demonstrate how species were particularly challenged by shifts, degradation or losses of their preferred habitats over the next 50 years. Because the TNC climate change analysis focused heavily on "ecological departure" of vegetative systems and the changes attributable to the invasion of exotic plants into native systems, our species-habitat associations also focused on our best estimates of wildlife species responses to the various "uncharacteristic classes" that defined ecological departure. One of the most important research needs identified as a result of this revision has been that of more specific knowledge of wildlife species tolerance/response to changes in their habitats incurred by exotic plant invasion, closing and opening of tree and shrub canopies, and species tolerance of conversion of shrub types to rabbitbrush, a common conversion among systems. This knowledge is critical in the adaptive management tracking and monitoring of climate change once this Revision takes effect.

In the evaluation of mammals and reptiles, we assessed wildlife species tolerance to uncharacteristic classes except in cases where we were fairly certain that the native plant community was severely reduced or replaced and the species in question was known to be strongly dependent on elements of that native plant community for either food or cover (Greater Sage-Grouse in sagebrush as an example). We had to make qualitative judgments as to whether a species would continue to occupy a habitat with low, moderate, or high invasion of exotic plants. We evaluated the species' response to relative changes in vegetative structure and how those changes would result in exposure to predation and the elements (sun, heat, cold, etc.). In some instances, species' responses to tree encroachment into non-tree habitats have been better studied than the invasion of annual grasses/forbs into the same habitats, so our predictions were thus better supported by existing research. The results of these analyses are reported in the "Possible Wildlife Responses to Climate Change" sections in each of the Key Habitat chapters.

Avian Responses

Great Basin Bird Observatory Climate Change Analysis

For modeling landbird population change, we used data from the first ten years of the Nevada Bird Count (NBC) and from recent landbird inventory projects in Nevada that used the same point-count design as NBC for assessing bird populations. Analyses were restricted to those priority species of the Wildlife Action Plan that are diurnal landbirds with relatively small breeding territories, because point count surveys are designed to estimate densities for these species. Species with large home ranges, waterbirds, shorebirds, and secretive marshbirds were not included in our analyses, nor were landbird species that were so rare in Nevada that reasonable density estimates could not be derived for their primary breeding habitats.

Bird Habitat Models

For modeling current bird habitat use, we used the raster map of current vegetation conditions from TNC (2011). The landbird data from the NBC and similar projects in Nevada were limited to observations within a 100 m radius distance from each survey point, because detectability of most landbirds decreases rapidly beyond this distance. A 100 m spatial buffer was created around each point and the percentages of each current vegetation cover type within that circle (3.14 ha) were calculated. Because of the heterogeneity of vegetation classes in most 100 m circles, a set of rules governing selection of the circles for use in calculating species densities for individual vegetation classes was created. (To review the point selection rules, please refer to the complete GBBO report within Appendix E.)

Bird density was calculated for each priority landbird species in each habitat type. For this, we calculated the average number of individuals (excluding fly-over observations) detected within 10 minutes and 100 m by taking the mean of multiple visits to each point. These numbers were then averaged over all points assigned to a particular habitat type, and extrapolated to the average detectable density per 40 ha. A working estimate of statewide population size was then estimated by multiplying the densities by the number of hectares currently in each habitat type, and summing over all habitat types in each of the 13 regions from the climate model, which can then be summed for the state. For some statewide habitat types, data for the Mojave region (which for the purpose of this report, included the Clover-Delamar region identified in TNC 2011) were separated from data for the Great Basin region, but most habitat types were largely restricted to one or the other.

Predictions of Climate Change Effects

The Team used current acreages and model projections for future acreages after 50 years of climate change for each condition class within biophysical settings (TNC, 2011) to project expected changes in landbird populations. These predictions carry the same limitations and assumptions as do the predictions for vegetation change, and also assume that habitat change will dictate most changes in bird populations (but see above for cautionary comments).

Projections for bird population change were calculated separately for the 13 regions in Nevada used in this analysis (for details on these regions, see TNC Climate Change Report, 2011). For birds with statewide breeding distributions, we summed habitat acreages across regions for one statewide total. Southern Nevada species were analyzed using only those appropriate regions (usually Mojave and Clover-Delamar). Some condition classes were projected to change greatly due to climate change, but some of these changes were not available in the current map, either because these classes are currently rare or because the available GIS layers cannot delineate them. In these cases, we made qualitative judgments about expected effects on the birds that occupy the changing habitats that were not mapped.

The results of the avian climate change response analyses are completely reported in the GBBO report, and results from the report are included in the “Possible Wildlife Responses to Climate Change” sections in each of the Key Habitat chapters where relevant.

Suitable Habitat Connectivity Climate Change Analysis

A fine-filter analysis of climate change effects on a roster of vegetative and spatial parameters with respect to bird distribution and suitable habitat connectivity was conducted by a team of wildlife and geospatial ecologists operating under the aegis of the University of California, Davis as a special project for this Wildlife Action Plan revision. The objectives of the project were to identify vegetative or landform characteristics that influence bird distribution on a small regional scale; assess the projected changes on those characteristics brought about by climate change; and evaluate the regional landscape's ability to provide alternate suitable habitat in accommodation of species' needs to shift distribution with climate change. The study identified areas most likely to be occupied by breeding birds associated with key habitats given current and potential land cover and climate, particularly areas that are likely to be occupied given a range of possible future conditions. The methods presented could also be applied to any group of animals for which sufficient date are available (Fleischman, et al., 2012).

Aquatic Habitats

Because the available TNC climate change analysis focused primarily on "ecological departure" of vegetative systems and associated changes to native terrestrial habitats, it provided limited utility for assessing changes to aquatic systems and associated effects on resident native aquatic species, particularly fishes. For a number of reasons it was not possible to develop more sophisticated modeling tools for identifying aquatic system effects at a detailed level, and a relatively coarse-filter approach was used to evaluate predicted climate change effects. After identifying watersheds containing priority aquatic species of concern for each key habitat association, available on-line tools were used to assess predicted changes for temperature and precipitation at a Hydrologic Unit (HUC8) level, using High A2 Ensemble Average GCM data sets for percentage departure through 2050, consistent with the analysis approach used for aquatic CCVI assessments. Although precipitation models in particular exhibit high uncertainty across much of the area of analysis this did allow some level of assessment of projected change in key climate change components likely to affect aquatic habitat suitability and allowed some evaluation of potential seasonal changes in aquatic system functions because of projected temporal shifts in precipitation and early spring onset, particularly important for the assessment of future conditions in stream and river habitats. These assessment results at the HUC or hydrologic basin level then were manually interpreted to deductively infer likely future effects on aquatic habitats and aquatic species based on known distributions.

APPROACH & METHODS:
Constructing Conservation Strategy

Once the threats to wildlife conservation posed by climate change or other agents of change were identified, strategies to reverse or mitigate the effects of those threats were solicited from technical expert groups, taken from the 2005 Plan, other conservation plans, or the literature wherever possible. The strategies, activities, treatments, prescriptions, programs, and initiatives were often unchanged from the 2005 Plan for the species persisting on the priority list from 2005. New species sometimes required new creative thinking, but more often than not could be grouped with a species or set of species already prioritized by the Plan. A feature of the TNC habitat analysis was the gathering of regional ecological restoration focus groups to construct restoration, remedial, and preventive prescriptions for action specific to their own regions based on their own expertise and experience.

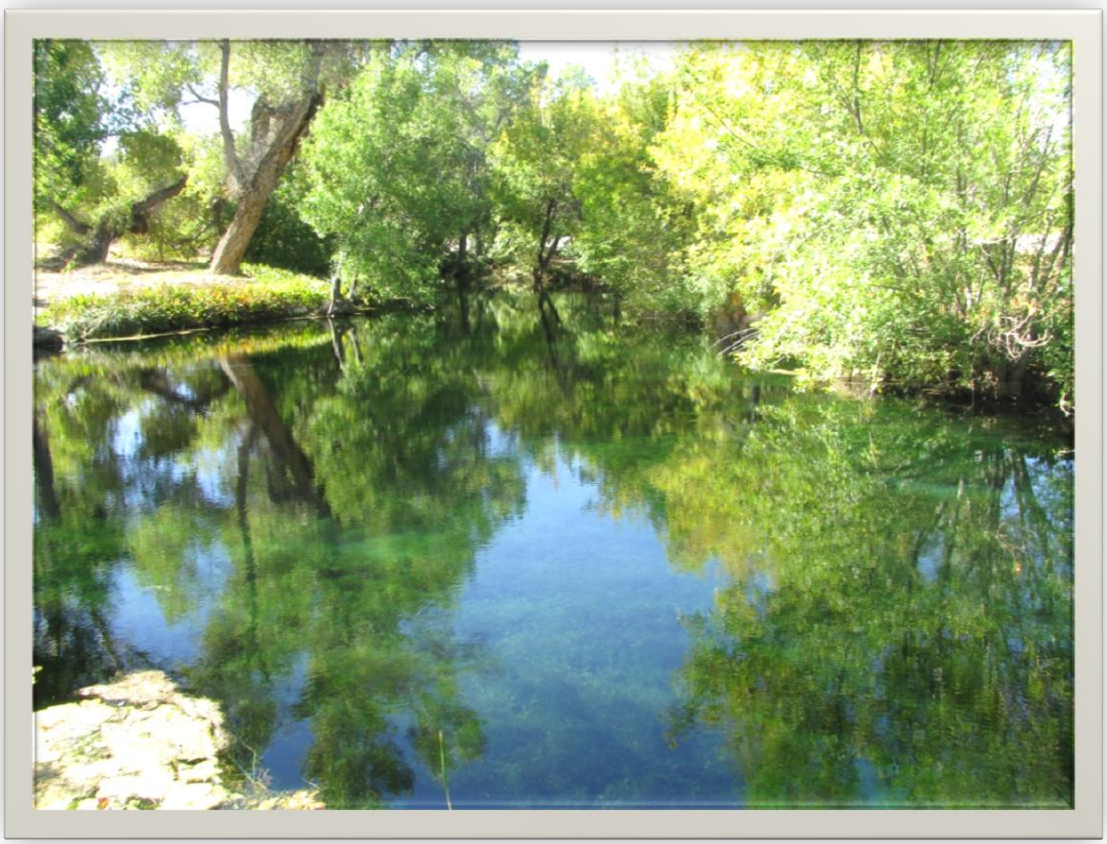
Once the basic prescriptive approaches were identified, the Revision Team strove to set quantified, measurable objectives to set the progress marks for the applications of those prescriptions. Where ecological departure of an ecological system (biophysical setting) was of major concern and had been quantified for the 50-year period of analysis, objectives aimed at reversing, stabilizing, or minimizing the rate of ecological departure of the ecological system were developed for the immediate 10-year period following approval of the Revision (2012-2022). A general finding of the climate change projections was that the period between 40 and 50 years from now would witness the greatest increment of change toward the 50-year projected outcome, and often the first 10-year period (that relevant to this revision) would witness the least. Setting up the monitoring framework to measure climate change effects was much more the need during this first 10-year period, and sometimes in terms of actually observing physical change on the landscape.

We also strove to construct quantified, measurable objectives for species population management in concert with each habitat management strategy. The detail of population information for different taxa controlled our ability to develop detailed objectives. Because our knowledge about the different priority species varies, we had to incorporate quantification parameters in line with the level of detail of our knowledge. The most highly developed population estimates for wildlife in Nevada occur for game mammals that are counted annually out of helicopters for the purpose of informing highly sophisticated harvest models and tag recommendations. Following game mammals, our skills in estimating breeding bird populations have been greatly enhanced by the analysis of 40 years of USGS Breeding Bird Survey data and also the analysis of ten years of Nevada Bird Count data. Both datasets are featured in the “Nevada Comprehensive Bird Conservation Plan” revised by Nevada Partners In Flight (facilitated by Great Basin Bird Observatory) in 2010. For game mammals and many breeding birds on the priority list we were able to construct quantified population objectives based on these survey results, and did so whenever we could.

For bird species where we had adequate data indicating regional or continental trend, but lacked data rigorous enough to project meaningful population estimates for Nevada, we set directional objectives based on increasing, stabilizing, or reversing trend depending on the severity and nature of the reported decline. Priority was usually given to regional trend over continental trend.

Population estimates could not be generated for most nongame mammals and reptiles. However, presence/absence monitoring technology has progressed significantly since 2005 and monitoring protocols that generate “occupancy rates” based on multiple visits to networks of sample sites are becoming more and more useful for understanding and tracking species status. The development of occupancy survey protocols for small mammals in sagebrush (Nevada WAP Sagebrush Indicators Technical Team, 2010) allowed us to develop objectives for “detectable levels” for tracking species status.

As with terrestrial species, strategies, activities, treatments, prescriptions, programs, and initiatives were largely unchanged from those developed for the 2005 Plan for aquatic species carried forward from the 2005 priority list, and new species added from the current analysis generally could be grouped with a species or set of species previously prioritized. The level of degradation of aquatic habitats supporting priority aquatic species in Nevada remains substantial because of both physical alteration and the presence of undesirable non-native species, and specific substantive threats to these habitats identified in the 2005 plan such as future groundwater development and invasive species remain largely unabated. To the extent that potential climate change effects identified in the analysis such as increased thermal input from air temperature rise and altered streamflow regimes resultant from temporal changes in precipitation and modified runoff patterns will modify aquatic habitat quality for priority aquatic species, these will be modifiers that to some extent will just amplify the impacts of existing threats. For this reason in many cases predicted climate change inputs did not substantially alter existing proposed actions, prescriptions and conservation targets, but place increased emphasis on the importance of those targets and prescriptions because their effective implementation generally will increase the resiliency of aquatic systems in the face of projected climate related effects.



Crystal Springs in Pahranagat Valley Photo Courtesy of R. Wilson

APPROACH & METHODS:
Revision and Review Process

Similar to the 2005 WAP draft process, NDOW contracted with the Nevada Audubon Director of Bird Conservation to serve as editor and principal author of the 2012 Revision. Duties of the editor included writing, editing, and draft layout design leadership throughout the draft process. Audubon Society personnel also provided conservation planning and design support as well as performing a major role in the public review. All members of the Revision Team either took on individual writing assignments or first-line text review duties during the creation of the review draft.

Species Vulnerability Assessment Expert Review

Species' range maps and natural history information were obtained from a number of sources including the Nevada Wildlife Action Plan (WAP) (Wildlife Action Plan Team, 2006), the NNHP Biotics database, The Revised Nevada Bat Conservation Plan (Bradley et al., 2006), Atlas of the Breeding Birds of Nevada (Floyd et al., 2007), The Nevada Comprehensive Bird Conservation Plan (GBBO, 2010), NatureServe Explorer, federal agency documents (e.g., USGS professional reports or published studies, USFWS Recovery Plans, Federal Register), field guides, and expert input.

Assessments were completed for a representative group of species within each taxonomic group. After these initial CCVI scores were calculated by NNHP, an expert workshop was held (December 2009 in Reno) to solicit feedback and comments from biologists working throughout Nevada. The two-day workshop was well-attended and included representatives from federal (BLM, EPA, NPS, USFS, and USFWS) and state (NDOW, NNHP) agencies, a non-profit organization (TNC), and academia (UNR). Highly constructive comments and feedback were obtained from the attendees on the scoring of the factors, and additional species information was also obtained to better inform the assessments. All feedback and comments were incorporated into the CCVI for each species and scores were recalculated.

Climate Change Management Strategy Development

TNC and NDOW staff held workshops in Carson City twice, Ely, and Las Vegas to seek expert knowledge on ecological system management for the Calcareous, Eastern Sierra Nevada, Elko, Lahontan, Mojave, and Walker regions. The goal was to develop coarse and representative management strategies to abate detrimental climate change effects and order of magnitude costs for regions belonging to different ecoregions. Ecological systems chosen for management were: aspen-mixed conifer, aspen woodland, blackbrush mesic and thermic, creosote bush-bursage, Jeffrey pine, mixed conifer, low-black sagebrush, montane riparian (non-carbonate), montane sagebrush steppe-mountain site, and Wyoming big sagebrush semi-desert. Proposed management strategies were very variable in type and cost among regions and agencies.

Public Workshops

NDOW and the Revision Team coordinated with state, federal, and local agencies, and conservation organizations to gather pertinent information for the plan revision. To initiate the planning process, NDOW and the Revision Team held a workshop in April, 2009 for NDOW employees and our conservation partners entitled, "Incorporating Climate Change into Nevada's State Wildlife Action Plan". Participants were asked to provide input on the challenges to managing wildlife and fish resources and what information the plan should include to assist in prioritizing wildlife management and conservation actions. An overview of the revision process was provided to the Board of Wildlife Commissioners in December, 2011.

A draft of the revised Wildlife Action Plan was posted on NDOW's website in January 2012 for public review. Public scoping meetings regarding the draft revised plan were held during the winter of 2012 in Elko, Las Vegas, and Reno. The workshops were advertized in the media and over 100 invitations were sent to agencies, industry, NGOs, hunting, fishing and environmental groups. Each of the Native American tribes in Nevada was sent a letter inviting them to the workshops. Follow-up calls were made to tribal members for a personal invitation to the workshops. At each meeting location, an afternoon workshop was held for professional natural resources managers and an evening workshop was held for conservation partners, industry, and the general public. Attendees at the meetings included federal and state resources agencies, county governments, tribes, sportsman's groups, recreation groups, university personnel, and others. Attendees viewed a PowerPoint presentation providing an overview of the draft revised plan and the revision process and an overview of the species and habitat analysis for the plan revision. A facilitate question/answer and input session followed at each workshop. Written comments regarding the draft plan were also accepted. The Revision Team held meetings following the workshops and public input period to review all written and verbal comments, and made adjustments to the draft plan accordingly.

In addition to the public workshops, Revision Team members had individual meetings to discuss the plan revision with a representative of the Nevada Farm Bureau and also with representatives of the Nevada Mining Association. Revision Team members also had a final meeting with the USFWS Ecological Services Nevada Offices in Reno and Las Vegas to review and discuss several items, including the final list of Species of Conservation Priority in the revised plan.

The Revision Team stayed in close contact with agency personnel throughout development of the draft plan. Coordination was maintained with the USFWS office in Reno and Las Vegas, the BLM State Office, and the Humboldt Toiyabe National Forest Supervisors Office. One of the primary strategies of the WAP is to integrate its objectives and actions with other agency planning processes to foster synergistic achievement of wildlife management objectives at a statewide scale.

The coordination of the Nevada WAP with tribal land management strategies continues to be important particularly in light of the federal Tribal Wildlife Grant Program. Tribal coordination will continue to be facilitated through the Nevada Indian Commission, which maintains liaisons with all the Native American tribes in Nevada. The WAP Revision Team will continue to extend its planning experience to tribes wishing to access Tribal Wildlife Grant funds to assist them in identifying priorities, program and project design and development, with the objective of integrating tribal wildlife priorities and management approaches into the Nevada WAP to achieve synergy between the two sister USFWS Federal Assistance programs.

NEVADA'S WILDLIFE HERITAGE

Nevada has rich and varied biodiversity, with all major groups of animals well-represented within its boundaries. Among the 50 states, Nevada ranks eleventh in overall biological diversity and is sixth in the nation for endemics, with 173 species found in Nevada and nowhere else in the world (Stein, 2002). Unfortunately, Nevada also ranks third, behind Hawaii and California, in the number of its species at risk of extinction.

From a wildlife perspective, the Great Basin and Mojave Deserts are landscapes of enormous subtlety. The vast and apparently monotonous expanses of sagebrush actually support dozens of species, and many more subspecies. Most of the animals accomplished at life in these deserts are colored to blend in with the rocks and vegetation to avoid detection in a land that holds few hiding places. Many specialize at being nocturnal to avoid the harshness of the desert sun. Explorer John C. Frémont declared the region as "deserving the full examination of a thorough exploration." One thing is certain - Nevada does not reveal its nuances to a car traveling 70 miles per hour across Highway 50.

Nevada's tremendous diversity of life is derived from its geologic past and its current geography. During the Pleistocene, this region of the globe was considerably wetter than it is today, with lakes covering significant portions of the state. As the Pleistocene waned and the Earth entered a drier, warmer period, these lakes receded and vanished, sometimes completely and sometimes leaving behind only isolated wetlands and remnant springs. Organisms such as springsnails (pyrgs) and pupfish that once resided in enormous lakes now persist in tiny seeps and springs, each population cut off from its nearest neighbor, often by miles of inhospitable desert. Over time, these populations have evolved into unique species and subspecies, each uniquely adapted to their tiny corner of the world and each found nowhere else.

Nevada's geography and climate also contribute to this isolation effect. Nevada is the driest state in the nation and also the most mountainous. The many mountain ranges with winter snow pack, trees, meadows, and tumbling streams are effectively isolated from one another by the arid and treeless basins that lie in between. This juxtaposition of landscapes has effectively created isolated islands of habitat, dubbed sky islands. For the less mobile species of small mammals, reptiles, amphibians, and some insects, populations have likewise become isolated from one another on these montane islands in the sky, and over time, some have evolved into new species or subspecies while others have gone extinct on certain mountain ranges but not on others (Grayson, 1992).

The principles of island biogeography explain other aspects of the state's diversity and the pattern of species across the landscape. Two of the tenets of this branch of ecology state that the number of species on an island will decrease with distance from the mainland (the source of species to populate the island); and the smaller the island, the fewer species the island can sustain. The "mainlands" for the Great Basin province are the Sierra Nevada and the Rocky Mountains. Moving eastward from the tree-rich Sierra Nevada, the number of tree species declines until, in central Nevada, ranges such as the Toiyabes and Monitors harbor only a few species (Wuerthner, 1992). A similar pattern occurs in eastern Nevada, where, moving through ranges from east to west, the trees decline in both diversity and in their affinity with the Rocky Mountains. A similar pattern has been documented in mammal populations in Nevada. Several species of small mammals (termed "boreal mammals" by Brown, 1971) are now more or less completely isolated on the tops of mountain ranges across the Great Basin between the Sierra Nevada and Rocky Mountains, but their current distributions cannot be explained by the "distance to mainland" theorem alone because ingress from the north during the Pleistocene cannot be ruled out (Grayson, 1992).

While mobile species like birds might be expected to be unaffected by the effects of distance and island size, such is not the case. The reduced number of plant species in the interior mountain ranges translates to lower habitat diversity, which in turn, offers fewer niches for birds to occupy, and thus fewer species overall.

Also worth noting is that abundant food and water resources beneficial to wildlife are concentrated in only in a few noteworthy places of the Nevada landscape. Across the remainder of the state, such resources are widely scattered at a low density. The distribution of wildlife tends to reflect this disjunct distribution of food and water resources, and therefore with few exceptions, wildlife species are not found evenly distributed throughout Nevada but only in certain places, and sometimes in quite high densities. This does not mean that Nevada ecosystems are not important to wildlife, only that fewer numbers of individuals can be sustained in any one area. In reality, this widely dispersed distribution pattern makes managing and conserving the state's wildlife diversity all the more important.

Mammals

The Nevada Natural Heritage Program recognizes 136 species of mammals that occur or historically occurred in Nevada. Of those species, American bison, gray wolf, North American lynx, Arizona cotton rat, and grizzly bear are considered to be extirpated (i.e., they no longer occur) in Nevada. Of these, only the Arizona cotton rat was confirmed in Mammals of Nevada (Hall, 1946). Details of the historical occurrences of the other four species are vague to nearly non-existent. One species and one subspecies, wolverine and southwestern otter, have not been confirmed in the state since 1936 and are most likely extirpated. However, a lone wolverine was detected roaming the Sierra Nevada's in California as recently as 2010 (USFWS, 2010) and occasional unconfirmed reports of southwestern otter persist. Two additional subspecies appear to have become extinct despite many recent and thorough surveys; the Ash Meadows montane vole, which was last observed in 1933, and the Hidden Forest Uinta chipmunk, which was last observed in 1931.

Five species (burro, wild horse, Norway rat, black rat, and house mouse) have been introduced into the state through their domestic associations with humans. The Rocky Mountain goat was not native to Nevada, but was introduced into the Ruby Mountains by NDOW in the 1960s as a game animal, and persists in small numbers today in the Ruby Mountains and the East Humboldt Range. One species, the nutria, was reported to have been brought in by fur farmers in the 1930s and released after the fur farming venture failed, however, if a wild population was temporarily established, no populations are known to occur today (J. Curran, NDOW (retired), pers. comm., 2005). The total number of mammal species present in the wild in Nevada today is generally regarded to be 129.

Nevada's native mammals belong to one of six orders – Insectivora (shrews and moles), Chiroptera (bats), Rodentia (squirrels, rats, mice, etc.), Lagomorpha (rabbits, hares, pikas), Carnivora (dogs, cats, weasels), and Artiodactyla (even-toed hoofed mammals or ungulates). Nearly half of Nevada's mammal species are rodents (62 species), followed in number by 23 bats, 21 carnivores, 9 insectivores, 7 lagomorphs, and 4 native ungulates.

As with many of Nevada's animals, current mammalian fauna have been significantly influenced by the past climate of the Basin and Range and Mojave Desert provinces. During the Pleistocene, the holarctic ice cap was much closer and ice occurred on the top of many of Nevada's mountain ranges (Grayson, 1993). This created a cooler, wetter climate that shifted habitat types, and the mammals associated with them, downslope and southward (Brown, 1973). With the advent of our current epoch, the Holocene, the recession of the ice cap left hotter, drier conditions that drove habitat types northward and back upslope, leaving the valley bottoms to species better adapted for drier, warmer conditions except in those cases where remnant wetlands were left behind (e.g., Pahranagat Valley and Ash Meadows). This directly explains the existence of isolated subspecies of montane vole in the two valleys mentioned above (although the Ash Meadows montane vole is now considered extinct), and with more investigation, could easily contribute to the explanation of the existence of several of Nevada's other isolated mammal subspecies, including Humboldt yellow-pine chipmunk, Hidden Forest Uinta chipmunk (now considered extinct), and the San Antonio and Fish Springs pocket gophers. The Palmer's chipmunk, native only to the Spring Mountains, is Nevada's only truly endemic mammal recognized at the separate species level.

Due to Nevada's basin and range topography, many occurrences of various mammals are highly fragmented. For example, multiple chipmunk species and subspecies, pikas, golden-mantled ground squirrels, yellow-bellied marmot, bushy-tailed woodrat, long-tailed vole, and western jumping mouse all have impressively fragmented populations (Brussard et al., 1998). Fragmented populations make these species highly vulnerable to extirpation and ultimate extinction. When these relict mammal populations blink out, often associated with anthropogenic effects, it is difficult if not impossible for other populations to re-colonize, increasing fragmentation even further and increasing vulnerability until eventual extinction occurs. Indeed, many of our mammal populations are shrinking and some sites have become extirpated. These extirpations may also eliminate genetically unique populations (Grayson, 1987).

Twenty-three species of bats occur in Nevada and are found in multiple habitat types including cliffs, mines and caves, trees, bridges, and other man-made structures. The numbers of species found in Nevada represent almost half of all the species found in the U.S. While historic numbers and distribution of bats are not known, it is certain that many of our species are patchy in distribution and have declined or are vulnerable to decline in the future. The Mojave Desert in southern Nevada represents the northernmost extension of the range of several bat species, including Allen's big-eared bat, big free-tailed bat, cave myotis, California leaf-nosed bat, and western mastiff bat. With the emergence of a relatively new disease called white-nose syndrome in the eastern U.S., many of our more common species may be vulnerable and could experience significant mortality if the disease spreads to Nevada. Additionally, as greener energy production is pursued, large-scale wind farms may significantly increase mortality of bats, especially migrating species.

Nevada's largest carnivore is the black bear, present in the Carson Range of the Sierra Nevada (along the north and east shore of Lake Tahoe) and in the Pine Nut Mountains. Mountain lions occur throughout the state and are thriving. Other carnivores include coyote, kit fox, gray fox, and bobcat. The red fox is making serious incursions into previously unoccupied range in eastern Nevada with its distribution generally on the move from northeast to southwest, but very little is known about the status of the Sierra Nevada red fox, a California subspecies that may or may not exist on the Nevada side of Lake Tahoe (a recent confirmed sighting near the Nevada border indicates that it is at least conceivable that the Sierra Nevada red fox might exist in Nevada). Mustelid carnivores include northern river otter, mink, long-tailed weasel, ermine, American badger, striped skunk, spotted skunk, and American marten. Of these, the American marten has experienced the most habitat loss and is now known only from isolated sites in the Sierra Nevada east of Lake Tahoe. Raccoons and ringtails round out Nevada's fairly rich carnivore community.

Mule deer were much less numerous in Nevada until the period between the 1920s and the 1950s, when federal land management agencies were created and a significant release from livestock grazing, mostly sheep, affected a massive montane shrub regeneration event resulting in a mule deer population boom (Wasley, 2004). Today, after a second population peak event in the mid-1980s, mule deer have been on the decline as wildfire has significantly impacted winter ranges throughout the state, reducing native vegetation and facilitating the invasion of exotic grasses and weeds. Bighorn sheep have been returned to much of their pre-settlement range throughout Nevada with significant assistance from an NDOW-sportsmen's organization partnership that has implemented a highly successful transplant program since the 1980s, utilizing capture/relocation techniques supported by an aggressive water development program. Pronghorn are currently enjoying a population boom in positive response to changes in range condition that are shifting from overall shrub dominance to more grass/forb-dominated vegetative communities. Rocky Mountain elk are also currently expanding their range across the state in response to improved range conditions with more significant grass components.

The effects of climate change on mammals are largely unknown, although there has been recent work that indicates a general up-slope and northward movement may be expected. Species of mammals already isolated and at high elevations such as pika may be more vulnerable to climate change than other species more widely distributed. Likewise, species dependent on particular habitat types that are expected to be strongly impacted by climate change, such as pygmy rabbit, may be more vulnerable than species that have greater ability to utilize various habitat-types.

Birds

According to the Nevada Bird Records Committee (NBRC), a total of 487 species of birds have been recorded in Nevada. Of these, about 129 species occur irregularly in the state as accidentals or vagrants (i.e., birds that are well out of the recognized range of the rest of their species). Of the remaining 338 species, 275 are known to breed in the state (Floyd et al., 2007) and a small percentage of our total bird species are year-round residents of the state. The balance migrates through Nevada in spring and/or fall or use the state as their wintering area.

The 487 species on Nevada's checklist of birds represent 49 Families in 17 Orders which is considerable diversity within the Class Aves for the driest state in the Union.

- Waterbirds are well represented here and include members of the Order Gaviformes (loons), Podicipediformes (grebes), Pelecaniformes (pelicans and cormorants), Ciconiiformes (herons, egrets) and Anseriformes (ducks and geese).
- Sixteen species of hawks and falcons of the Order Falconiformes regularly occur in the state.
- Representative of the Galliformes (grouse and quail) can be found almost everywhere in Nevada.
- Wading birds, shorebirds, gulls, and terns are well represented by Gruiformes and Charadriiformes, though the vast majority of the diversity in shorebirds occurs in the state during spring and fall migration.
- Columbiformes include the doves, which range from the Mojave Desert to the higher elevations of the numerous mountain ranges. One recent invader, the Eurasian Collared-Dove, may be the newest bird species on Nevada's list. The Collared-Dove began its incursion into the state in Clark County where it is now seen regularly. The species also appeared recently in Washoe and Elko counties.
- The Cuculiformes include the (Western) Yellow-billed Cuckoo, a candidate for listing under the Endangered Species Act, which was probably once fairly well represented in the state, and the Greater Roadrunner, which remains fairly common in the Mojave Desert.
- Owls of the Order Strigiformes are broadly distributed across Nevada. The Great Horned Owl is probably the most common species in this Order.
- The Caprimulgiformes are also abroad at night, and these include the goatsuckers and nighthawks.
- In the Order Apodiformes, the hummingbirds are surprisingly diverse in Nevada. This order also includes swifts.

- The Belted Kingfisher, found state-wide along streams and rivers in the state, is the single representative of Coraciiformes.
- Piciformes (woodpeckers) are found in Joshua trees and riparian stringers in the Mojave Desert, to the montane forests of the state's higher elevations.
- Finally, the Order Passeriformes includes all of the songbirds, a huge Order. In this Order in Nevada there are numerous species of flycatchers, jays, vireos, swallows, wrens, thrushes, warblers, tanagers, towhees, sparrows, blackbirds, and finches.

No species of bird can be classified as endemic to Nevada–a native occurring here and nowhere else. One species–the Himalayan Snowcock, occurs only in the Ruby Mountains of Nevada and nowhere else in North America. However, this species is non-native, being introduced from Asia, and is managed as a game bird.

Avifaunal diversity in Nevada is linked to a variety of factors, the most dominant of which is the state's geography. With 314 mountain ranges, an elevation range of 150 - 4,000 m (480 - 13,140 ft), two deserts, portions of four ecoregions, seven major habitat types, and 22 "key habitats," the state offers considerable habitat diversity for birds. Other factors affecting bird diversity and linked to geography to varying degrees include precipitation patterns, continental bird migration patterns, and the dominant Basin and Range topography of the state.

With a few noteworthy exceptions, birds in Nevada tend to be distributed at low densities across the landscape. This distribution is probably a reflection of food resources, which likewise tend to be rather widely dispersed in the Great Basin and Mojave Deserts. The exception to this generality usually occurs in the few locations in the state where water also occurs in abundance. In high water years, places like the Lahontan Valley and Franklin Lake Wildlife Management Areas, can teem with remarkable numbers of waterbirds. Ruby Lake National Wildlife Refuge, which has a fairly reliable water supply, supports good numbers of birds throughout the year. A few locales across the state regularly support large numbers of colonial breeding birds. Pinyon Jays, a noisy, conspicuous, and gregarious bird, concentrate in large flocks where piñon pine nut crops are abundant and constitute an exception to the rule of water as the attraction for concentrations of birds.

As we see with other animal groups, the topography of the Great Basin contributes significantly to the distribution and abundance of birds. Nevada's basins tend to be arid expanses of low desert shrub-dominated landscapes. However, some basins hold winter run-off for short periods of time, offering critical stop-over sites for waterbirds in spring migration. Fewer still are the basins that have permanent water sources, and these places offer habitat values to birds that far exceed the small extent of the watered lands.

These arid basins separate the north-south trending mountain ranges, which due to effects of elevation and aspect, tend to be better watered and support forests of piñon-juniper, pine, fir, spruce, oak, and aspen. For less motile species of mammals and reptiles, the basins constitute a significant barrier to movement and can lead to isolated populations and the rise of endemism. But for birds the basins may only be a deterrent to movement on a short term basis, as these landscapes are readily traversed during migration or after juvenile birds disperse from their nests.

Moving from the low-elevation basins to the ridge lines of adjacent mountain ranges it is possible to cross through eight elevationally defined vegetation zones. Each of these zones–Absolute Desert, Lower Mojavean, Blackbrush, Saltbush, Sagebrush, Pygmy Conifer, Montane, and Alpine–have their own characteristic suite of birds. Even the driest and apparently inhospitable landscapes have birds, at least during some portion of the year. Many species of desert birds are adapted to life without access to water. These species meet their water needs through their solid diets of seeds, insects, fruit, reptiles, or small mammals, and also through behavioral and physiological adaptations that help to conserve water.

The bird community of the Mojave Desert of southern Nevada is distinctly different from the Great Basin Desert bird community. The Mojave Desert extends well south from southern Nevada into California and Arizona as do many of the ranges of the bird species that inhabit it. The Greater Roadrunner, Vermilion Flycatcher, Gambel's Quail, Inca Dove, Ladder-backed Woodpecker, and Verdin are a few of the species characteristic of this landscape. Likewise, species like Greater Sage-Grouse and Bobolink that typify parts of the Great Basin landscape are absent from the Mojave. The altitudinal influences on vegetation, and accordingly, bird communities, still holds true for the Mojave.

Two major mountain ranges flank the Great Basin and also influence bird communities. On the western edge of the Great Basin lies the Sierra Nevada Range. Because of their altitude, rainfall, and proximity to the markedly different climate of the Pacific coast states, the Sierras have their own bird community, distinct from what is found elsewhere in the state. Although only a small portion of the Sierras occur in Nevada, the Sierra Nevada Ecoregion is the only place in the state where birds such as Mountain Quail, Red-breasted Sapsucker, White-headed Woodpecker, and Pygmy Nuthatch occur reliably. It is also the locale for even rarer occurrences of species such as the Pileated Woodpecker and the Great Gray Owl.

On the eastern flank of the Great Basin lie the Rocky Mountains. Positioned as they are in eastern Utah, their influence on Nevada's avifauna is moderated by distance. Nonetheless, species in eastern Nevada certainly show a greater affinity with this extensive mountain range. Species such as Black Rosy-Finch and the American Three-toed Woodpecker are a part of the northeastern and east-central Nevada landscape, but have their population centers in the Rocky Mountain states.

Pacific Flyway

Nevada lies within the Pacific Flyway, the primary seasonal movement corridor for waterbirds migrating west of the Rocky Mountains. The majority of waterbird migration in this flyway takes place west of the Sierra Nevada, with another concentration of birds following the Rocky Mountains. However, due to the occurrence of some strategically-located large wetlands (Lahontan Valley, Ruby Lakes), significant numbers of ducks, geese, shorebirds, and wading birds do cross Nevada on their journeys between breeding and wintering grounds.

This particular component of the great migration phenomenon adds significantly to the diversity of species in the state. Birds which breed thousands of miles away in the high arctic or in the bays and coves of the Pacific Coast stop each year at wetlands in Nevada. These migration stop-overs provide foraging and resting opportunities and critical fuel for the extraordinary journeys required of migrants. Positioned as it is in the flyway, Nevada has significant responsibility for the maintenance of these populations.

Raptor and Passerine Migration

Raptors save critical energy in migration by utilizing upwelling air currents generated by air rising up mountain slopes to maintain altitude and north-southward momentum. With 314 mountain ranges nearly all oriented along north-south axes, this orographic effect is widespread in the state. Most mountain ranges in Nevada probably support a raptor migration, although the migration appears to be diffuse across the landscape, in part because mountain ranges are so abundant. The one noteworthy exception to this diffuse pattern of movement is the Goshute Mountains. Here several mountain ranges converge from the north and concentrate raptor movements along the Goshutes, which act like the throat of a funnel. As many as 20,000 raptors of at least 13 species have been recorded passing over the Goshute Mountains by HawkWatch International (Smith and Vekasy, 2001).

Little research has been conducted on migration of the Passeriformes through Nevada. Because the Great Basin is a hostile setting for most songbirds, migration through the Great Basin is fraught with risk. Though major passerine migration routes circumvent the Great Basin by following the Sierra Nevada and Rocky Mountain ranges, significant numbers of passerines do cross Nevada with a surprising degree of diversity. Springs, seeps, streams, and lake shores are critical to sustaining these birds as they cross the desert. North-south trending valleys with surface water, such as Oasis Valley, Meadow Valley Wash, Pahranagat Valley, and the White River Valley likely concentrate migrating songbirds. The evidence for this phenomenon is strong in Oasis Valley (McIvor, 2005), but poorly researched elsewhere.

Climate change could affect birds in a variety of ways, including wide-scale shifts in vegetation type and cover; changes in migration and breeding timing; changes in the availability of food and water, especially critical during the breeding and migration seasons; and direct effects of increasing temperatures and altered precipitation patterns on individual species (GBBO, 2011). Perhaps most troubling are expected “decoupling” of peak food availability with peak breeding season and the expected earlier migration patterns of species that would put them in areas too early for adequate food production; and distributional shifts caused by large scale, extreme events such as fires and disease outbreaks. Research into these topics is on-going, but these effects are currently fairly unknown. Research of these topics is on-going; some of which are featured in the analyses for this Plan Revision.

Reptiles

There are 56 native reptile species recognized in Nevada, consisting of 15 families and 36 genera. Of these 56 species, three species have two recognized subspecies that occur within Nevada’s boundaries. The Nevada Natural Heritage Program recognizes one additional species, the Mexican garter snake, based on a historical occurrence, however, it is presumed extinct in Nevada. One lizard, the Mediterranean house gecko, and five turtles are introduced species.

Nevada’s native reptiles can be categorized in three major groups: turtles (one species), snakes (26 species), and lizards (24 species). Several species, including the desert horned lizard, western whiptail lizard, long-nosed leopard lizard, gopher snake, and striped whipsnake are quite common, utilize a variety of habitats, and are found essentially throughout the entire state; while others have restricted habitat requirements or are found in small isolated populations in Nevada, such as the northern alligator lizard, western red-tailed skink, Sonoran mountain kingsnake, and the western diamondback rattlesnake.

Many of Nevada’s native reptile species can be categorized as either Great Basin or Mojave Desert species. Typical Great Basin reptile species include the western rattlesnake, northern rubber boa, and the greater and pygmy short-horned lizards. The warmer year-round temperatures associated with the Mojave Desert provide habitat for a diversity of numerous heat-tolerant reptile species such as Mojave desert tortoise, chuckwalla, desert iguana, western banded gecko, Smith’s black-headed snake, glossy snake, and the sidewinder rattlesnake.

Many of Nevada’s reptile species possess unique and varied characteristics and habits. Several lizard species, including the chuckwalla and desert iguana, are chiefly herbivorous, while most other lizard species are omnivorous, and all snakes are carnivorous. Nevada is home to three horned lizard species. The greater and pygmy short-horned lizards occur in the Great Basin and Columbia Plateau, are viviparous, and give birth to live young. The desert horned lizard occurs in the Mojave Desert is oviparous, laying eggs which contain the next generation of lizards.

Most reptile species can be categorized as either diurnal (active during daylight hours) or nocturnal (active at night). The desert night lizard, night snake, and spotted leaf-nosed snake are all nocturnal, while the coachwhip, western yellow-bellied racer, desert spiny lizard, and the Great Basin collared lizard are all examples of diurnal species. The lyre snake, which occurs in the Mojave region, is unique in that it immobilizes its prey via venom directed along grooved teeth. Although venom is usually exclusively associated with rattlesnakes, in addition to the lyre snake, the gila monster, one of only two venomous lizards in the world, also uses this adaptation in their pursuit of food. One Nevada reptile species, the desert tortoise, is currently listed as Threatened on the federal List of Threatened and Endangered Species. This is due primarily to habitat loss and disease.

One subspecies of aquatic reptile, the northwestern pond turtle, may be a Nevada native. The pond turtles' origin remains undetermined as genetic tests have not shown significant differences among the widely distributed populations (Washington state to Baja California). Records do show that pond turtles were present in Nevada near the beginning of the 20th century. More sensitive testing is needed to gain a clear understanding of the genetic affiliation of the Nevada populations.

The body of published literature pertaining to Nevada's reptiles is small. Much work is needed to fill the knowledge gaps for many species. Many snakes and lizards, especially those that are cryptic and/or nocturnal, are difficult to survey; therefore, much information is lacking. In many cases, we are still documenting presence/absence of species, as evidenced by the recent confirmed documentation of the only known Nevada occurrence of the rosy boa (Mulks, 2011). In recent years, considerable knowledge has been gained but this group of animals will remain a group that requires much attention.

While intuitively it may seem that reptiles would be the one group of animals more resilient to climate change as many are already adapted to hot, dry conditions, there is evidence that this may not be the case. For example, in the Mojave Desert, many reptiles are closely tied to the shrub overstory, which provides critical shade habitat during the day. These shrubs are predicted to contract with climate change, thereby fragmenting dependent reptile populations. In addition, in the search for cleaner, alternative energy, large areas of the Mojave Desert are proposed to be developed for large solar producing power plants. These large-scale developments could cause significant habitat fragmentation and the likely extirpation of many populations. In the north, as wildfires increase and the extent of non-native annual grasses increase, loss of habitat is also likely to significantly affect Great Basin reptiles.

Aquatics

Amphibians

Amphibians are typically found associated with aquatic resources in Nevada and are considered important indicators of ecological health in areas where they would normally be expected to occur. Much like other aquatic-dependent biota, their distribution is sporadic in association with the distribution of water resources in this arid environment, and isolation of amphibian species and sub-populations has resulted in a high level of endemism and metapopulation uniqueness in proportion to the small number of amphibian species statewide. This metapopulation isolation and relative scarcity across the landscape also makes Nevada amphibian populations particularly susceptible to localized habitat alterations and short-term climatic changes such as extended drought. Their life history (an aquatic and a terrestrial phase) and very permeable skin also make them highly sensitive to ecological changes.

Fifteen native species of amphibians have been found in the wild in Nevada, all within the order of Anura (six frogs, eight true toads, and one spadefoot toad). One species of frog, the Las Vegas Valley leopard frog is believed to be extinct, and another, the Sierra Nevada yellow-legged frog, is thought to be extirpated from Nevada. The relict leopard frog was once believed to be extirpated from Nevada, but was rediscovered near Lake Mead in the 1990s. Two additional amphibian species found in Nevada are introduced – the tiger salamander and the bullfrog.

Relatively good amphibian distribution data is limited to a few species (Columbia spotted frog, Amargosa toad, and the relict leopard frog). Anecdotal information for some species, such as Pacific chorus frogs and western toads, indicates that their populations are relatively stable, but there is little official documentation. Other species, such as the northern leopard frog appear to have shown declines in statewide distribution compared to historic accounts, but again, documentation is limited. Although worldwide amphibian population declines and extinctions are cause for concern, there is some evidence that detected declines in most Nevada species can be attributed largely to local identifiable factors such as short-term climate cycles and alterations to habitat quality and availability. However, the absence of good data, particularly for widespread and patchily distributed species such as the northern leopard frog, western toad, and chorus frog, makes accurate determination of status and trend for many native amphibian species difficult at best, and limits the ability to develop and implement proactive conservation actions if required.

Because most of Nevada’s native amphibian species are closely linked to surface water resources for at least some portion of their life cycles, effects, in some situations substantive, can be anticipated from climate change but those effects will be variable depending on the species and geographic location within the state. True frogs including Columbia spotted and northern leopard frogs in central and northern Nevada are dependent on persistent standing water ponds and perennial streams; shifts in precipitation patterns that may encourage early onset spring runoff and increased summer period temperatures could negatively impact the extent and duration of wetland, montane pool, and perennial stream habitats and could be expected to have a corollary effect on distribution, reproductive success, and metapopulation connectivity for these species. In contrast, some Mojave Desert species, such as red-spotted and Woodhouse toads, are dependent on ephemeral pools for their reproductive strategies. Anticipated shifts in monsoonal precipitation patterns in southern Nevada could actually increase the distribution and duration of reproductive habitats for those species although as for all aquatic species, a high level of uncertainty in available precipitation models makes specific predictions difficult.

Fishes

More so than terrestrial wildlife species, the taxonomic diversity and distribution of Nevada’s fishes are influenced by our state’s geologic and hydrographic history (Hubbs and Miller, 1948; Hubbs et al., 1974). Throughout the Great Basin ecoregion, glacial and postglacial changes in climate and hydrology have alternately connected and isolated hydrologic systems and their associated biota, creating a globally unique endemic aquatic fauna surprising in its diversity and much at odds with current climatic conditions. Conversely, significant parts of Nevada’s land area fall within the larger Colorado River, Snake River, and Bonneville drainages, and support endemic fauna specifically representative of those systems, although frequently also with unique adaptations as a result of isolation from climatic and geologic change.

With settlement and development of Nevada, its endemic aquatic fauna has been augmented with a wide variety of introduced fish species, many from the Mississippi River drainage and associated systems. Dominating many of Nevada's lakes and reservoirs, introduced centrarchid fishes represent challenges for managing endemic species, but support diverse and important sport fisheries. Stream and river systems, particularly in central and northern Nevada, support primarily salmonid fisheries with both native and introduced trout species. Beginning in the early 20th century, aggressive introduction programs established non-native trout species, including brook, brown, and rainbow trout, in many stream and river systems statewide, and the majority of those waters still maintain important recreational fisheries to this day. More recent sport fish management efforts have focused on the conservation and expansion of remaining populations of native salmonids such as cutthroat, redband, and bull trout, while maintaining sport fishing opportunities through the stocking of non-native trout species in appropriate locations.

Although approximately 151 species or subspecies of fishes have been found in the wild in Nevada, at least 37 of these are nuisance introductions of species that have no commercial or recreational value, or are incidental observations of non-native species which may not persist in the wild as viable populations. Twenty species of non-native game fishes, the majority of them occurring from intentional introductions, support a significant part of Nevada's recreational sport fisheries.

Nevada's endemic fish fauna consists of at least 87 described species and subspecies, although the precise number is difficult to determine. Taxonomic and systematic description of this diverse resource is ongoing with a number of potential endemic fish subspecies still poorly defined. The heritage of Nevada's complex geological and hydrographic history is reflected in the systematic and genetic relationships within its native fishes.

Because of the isolated and biologically unique nature of many endemic fish populations, and alterations to aquatic habitats which have occurred over time, a significant proportion of Nevada's endemic fish species are afforded protection under state statutes or the federal Endangered Species Act. Twenty-six Nevada fishes are listed under the ESA (19 as endangered and seven as threatened), and an additional 23 species or subspecies are listed under Nevada Administrative Code (NAC) as protected, endangered, and threatened fish (12) (NAC 503.065) or sensitive fish (11) (NAC 503.067). These 49 species or subspecies represent more than half of Nevada's endemic fish biota as currently defined. Active conservation programs are in place for a majority of these fishes to varying degrees, ranging from a few federally sponsored recovery programs to cooperative working groups and conservation implementation processes under state and partnership leadership. In all cases, significant challenges exist to effective fish conservation, principally from intentionally or illegally introduced aquatic species and the difficulty of addressing and correcting alterations to the landscape and aquatic habitat systems which have occurred over the past 140 years.

As with other aquatic species, climate change effects on Nevada's native fish fauna could be in some cases substantive, but those effects will be highly variable dependent on the species, the nature of the aquatic system, and location within the state. Thermal endemic native fishes occupying spring systems tied to regional carbonate aquifer systems are likely to show the most limited effects at least in the short term, but spring-dependent species reliant on non-carbonate and local recharge regimes such as relict dace, White River spinedace, and many speckled dace subspecies could be subjected to negative changes in available habitat and volume of flows depending on alterations in timing and duration of seasonal precipitation, particularly as altered snowpack conditions affect local recharge regimes. For native salmonid species in particular, but to some extent all endemic fishes occupying intermountain river and stream systems, predicted increases in interannual air temperatures coupled with potential changes in precipitation patterns suggest that modified flow regimes may become more prevalent over the next 20 to 30 years particularly in northern and north-eastern Nevada, characterized by earlier onset of spring runoff, reduced baseflow during mid- to late-summer periods, and associated increases in in-channel seasonal water temperatures. Potential implications for resident fishes include a reduction in suitable habitat quality and availability, impacts on individual fish recruitment, survivorship and reproductive success, additional fragmentation of stream systems that already may have limited connectivity with resultant effects on metapopulation dynamics, and loss of total available habitat in some stream systems particularly at lower elevations.

In Mojave River and stream systems such as the Virgin River, potential effects are less predictable largely because of the higher uncertainty of future precipitation models. However, likely changes in both precipitation and temperature for these systems suggest earlier onset of spring runoff events, reduced early- to mid-summer base flows, and an increase in stochastic flood events associated with shifts in summer monsoonal storm patterns. Although periodic flood events are important for maintaining in-channel habitats in these systems, reduced summer and fall base flows are likely to increase the frequency of instream conditions approaching or exceeding thermal maxima for many native fish species such as Virgin River chub and flannelmouth sucker.

Aquatic Mollusks-Bivalves

Five species of true freshwater mussels (order Unionida) have been reported in Nevada and are assumed to be native. The majority are in the family Unionidae (California Floater, Oregon Floater, Winged Floater, Western Ridged Mussel). The Western Pearlshell belongs to the family Margaritiferidae. Freshwater mussels are found in various aquatic habitats, and have an interesting life history. Some are known to live over 100 years, and many have a unique mechanism for larval dispersal. Freshwater mussels need a fish, or uncommonly an amphibian, host during their early developmental stage. This behavior is unique among bivalve mollusks, and also links the health of their populations to that of their fish hosts. When appropriate hosts are lost from a system, freshwater mussels are unable to reproduce. The majority of freshwater mussel records (which are very few in number) are occurrences of the California Floater in the Humboldt River system. The Western Ridged Mussel has also been documented at a limited number of sites. Discussions with numerous field staff from NDOW, other agencies, and researchers indicate a much wider distribution of freshwater mussels in Nevada, but limited to the northern half of the state. Also, shells have been found at numerous locations, indicating at least historical presence. Since live freshwater mussels are imbedded in the substrate they are not casually detected unless there are mortalities.

Fingernail clams and pea clams, small bivalves usually only a few millimeters or less in size, are not technically freshwater mussels. They belong to the order Veneroida, family Sphaeriidae, and are not dependent on a host. They appear to be widely distributed throughout the state, and hundreds of records are available for them, primarily through scientific collection activity reports supplied to NDOW.

No Nevada mollusks are either federally or state listed. However, the California floater is ranked in Nevada as critically imperiled by the Natural Heritage Program, and has been included on the list of Aquatic Species of Conservation Priority. Little is known about Nevada bivalves, especially historic and current distributions and population trends. Hosts have been identified for relatively few species of freshwater mussels. Genetics of the California Floater and other western mussels are currently being studied to assess whether distinct populations occur within different watersheds (Xerces Society, 2011). Some key questions regarding bivalve mollusks in Nevada are distribution, genetics, and host species. Invasive mussels and clams are highly detrimental to native populations and can cause significant impacts to ecosystems. More information can be found in the invasive species section of this plan.

Aquatic Mollusks-Gastropods

Freshwater, gill-breathing mollusks occur throughout North America, primarily in springs. More species of *Pyrgulopsis*, the largest genus of springsnails (pyrgs), occur in the Great Basin than anywhere else in the U.S.

Most springsnail (pyrg) populations are highly isolated because springs and seeps are widely dispersed and disconnected. Indeed, many species' entire range is in just one small spring. A number of springsnail (pyrg) populations are declining, almost faster than we can learn about them. Their aquatic habitats are rare and sensitive to drought and to the manner in which water resources are used.

Much remains to be learned about the diversity of Nevada's gastropod populations, their distribution, conservation status, and special ecological functions. Over 100 species of freshwater snails have been documented in Nevada. One species of *Pyrgulopsis* was recently added to the federal candidate list (the elongate mud meadows springsnail (*Pyrgulopsis notidicola*) but none are currently afforded state protection. As scientists continue to monitor and survey populations, new species will likely be described and more will be learned about Nevada's exceptional gastropod diversity.

Because native gastropods are largely dependent on isolated, often small but persistent springs and associated spring outflow habitats, climate change effects will vary dependent on the individual springs where they occur and how those springs are associated with various groundwater hydrologic systems. Larger, often thermal, springs associated with regional carbonate aquifer systems are likely to show limited effects from climate change at least in the shorter term over the next 50 years. The future condition of springs associated with non-carbonate aquifers and more local recharge systems is more uncertain, as changes in the timing and duration of precipitation and runoff patterns has the potential for more direct effects on surface water discharge. Regardless, almost all spring outflow systems have the potential for effects from increased air temperatures as this impacts both springbrook lengths and total wetted discharge areas.

Crustaceans

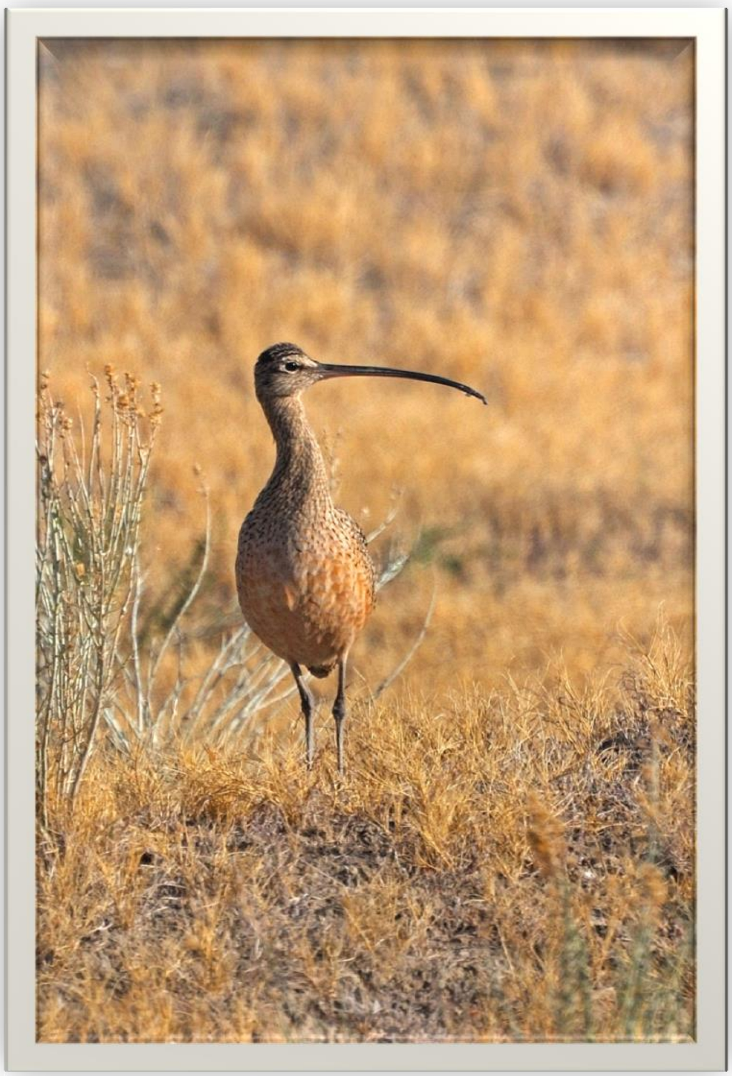
There are approximately 30 identified crustacean species in Nevada, falling into three classes: Malacostraca (crayfish, amphipods, scuds, and others), Ostracoda (ostracods), and Branchiopoda (fairy, clam, and tadpole shrimp). Most crayfish species found in Nevada have been introduced and exist outside their native range; these introduced crayfish are one of the major problems facing many of Nevada's Aquatic Species of Conservation Priority. Some of the main impacts of non-indigenous crayfish to warm water fauna include predation upon early life stages of fish and amphibians, and also on adult life stages of small-bodied fish (most of the ESA-listed fish in Nevada fall into this category). Non-native crayfish also compete for resources at the expense of native species. The emphasis is therefore to prevent the spread of non-native crayfish into areas where they do not yet exist, and control or eradication of introduced crayfish where they threaten other aquatic species that are at risk. Most of the crayfish introductions probably occurred through the release of live bait. Actions have been identified in various conservation plans to reduce or eliminate introductions that have proved detrimental to important native aquatics.

There is little documentation of Nevada's macroinvertebrate crustacean species, many of which are ephemeral pool specialists (e.g., fairy shrimp and tadpole shrimp). In order to survive the temporary, often harsh environments they inhabit, part of their life cycle includes an encysted egg that can survive long periods of desiccation and temperature extremes. These species are not included on the WAP Species of Conservation Priority list because so little is known about them in Nevada.

Aquatic Insects

The Nevada Department of Agriculture has jurisdiction over insects. Their mission is to encourage the advancement and protection of agriculture and related industries for the benefit of Nevada citizens. Their focus, therefore, is on insects detrimental to agriculture. The Nevada Natural Heritage Program tracks sensitive insects. Further information can be found at the Nevada Natural Heritage Program (www.heritage.nv.gov) and on NatureServe Explorer (www.NatureServe.org).

In the 2005 Nevada WAP, it was stated that the WAP Team would convene a working group of key conservation partners from the University of Nevada, Reno (UNR), Great Basin College and other partners to develop a conservation strategy for terrestrial invertebrates as a task in a future phase of WAP development and implementation. Due to the retirement of key partners at UNR, this effort did not come to fruition during the implementation of the 2005 plan and it was not pursued in the 2012 revision. We will however, continue to work closely with key conservation partners such as the USFWS, U.S. Forest Service, Nevada Natural Heritage Program and others in the conservation of terrestrial invertebrates and other sensitive species in landscape-level planning documents such as the Spring Mountains National Recreation Area Conservation Agreement and Strategy.



CHALLENGES IN WILDLIFE MANAGEMENT

Nevada is uniquely challenged in approaching effective wildlife conservation, in part because of its generally arid climate, geography, and relative scarcity of water resources, which has created a unique endemic biota easily subject to threats and stressors. Beyond these inherent conditions, however, human factors including a long history of land use activities altering natural habitats, recent intense urban development, and the widespread occurrence of invasive plant and animal species must be addressed to ensure the effectiveness of conservation actions and the maintenance of wildlife and their habitats into the future. When coupled with natural stressors such as periodic, but unpredictable, drought conditions from short-term climatic variation human related stressors can create a compounding effect which significantly influences the ability of habitats to maintain wildlife diversity on a landscape scale. Although some of these anthropogenic stressors, such as urban development and large-scale modification of hydrologic systems for water supply and flood control, may not be reversible and are necessary costs associated with human settlement and needs, others can be managed or corrected in ways that reduce negative effects or positively assist in implementing conservation.

Although Nevada's unique landforms and natural history are important elements in understanding and addressing the challenges inherent in developing this strategy to comprehensively conserve our wildlife resources, it must be understood that challenges for species and habitats across Nevada are closely tied to anthropogenic land use activities. Any strategy for addressing these challenges and effective conservation must include a definition and attempt to understand the stress on species and their habitats. In the broad sense, the sources of stress can be categorized into actions related to agriculture, hydrology, recreation, natural resources extraction, development, military activities, and a few additional actions which do not fall into these general areas.

Although organized agricultural activities are not a significant broad-scale stressor in Nevada, where they do occur, land-use actions such as agricultural and pasture conversion can influence wildlife through loss of native vegetation communities and species diversity, changes in vegetative structure characteristics, and increased disturbance to wildlife. Improper agricultural practices have the potential for significant local impacts; water and soil pollution can occur from improper waste management in intensive agriculture operations such as feedlots; and improper application of pesticides and herbicides can cause incidental mortality of non-target sensitive species and disruption of physiological processes, including reproduction. Improper soil conservation practices cause soil erosion and sedimentation of streams and floodplains, and the improper application of fertilizers can result in nutrient loading of streams and contamination of animal tissues.

Animal Disease

The principles of disease in wildlife are adherent to the epidemiological triad which states that disease results from the interaction between the host, the environment, and the disease agent (pathogen or chemical). Each of these components (host, environment, and agent) can influence the others and factors within each component may change the contribution of the component to the development of disease. Critical factors which affect the host component include age, sex, genetics, nutritional, physiological and immune status, and prior exposure to pathogens. Environmental factors influencing the host include climate, habitat, and interactions with other species, host densities and aggregation indexes.

The occurrence of disease in wildlife can be a natural phenomenon or anthropogenically driven. Human generated influences that have been tied to wildlife disease events have been broadly divided into three categories; environmental change, climate change, and ecological change. Factors within each of these categories alter other physical and biological processes thus affecting the epidemiological triad and increasing the risk and/or incidence of disease events in wildlife populations across Nevada's eco-regions.

Environmental Change and Disease

- Electromagnetic fields (characterized by low intensity, variety of signals, and long term duration cell phone towers, etc.): Studies of electromagnetic field exposure on wildlife indicate that there may be impacts to behavior, reproductive success, growth and development, physiology and endocrinology, and oxidative stress potentially increasing carcinogenesis.

- Exposure to and accumulation of pollutants (which may lead to reduced habitat quality): Reported and predicted effects include impaired reproduction, impacts to the immune system (primarily a decrease in effectiveness) resulting in an increased incidence of infectious disease or carcinogenesis. Pollutants found in water may be of greatest importance to species within Nevada and toxicity from heavy metals, salts and petrochemicals found in evaporation ponds associated with the mining and energy industry and toxic algal blooms have been documented.

- Ozone depletion: An increase in exposure to UV radiation has been reported to have a detrimental impact on species of amphibians. Negative effects included abnormal development or decreased hatching success due to cellular damage, depression of the immune responses and an increase in cancer development. Impacts appear to vary between species and life stages. It is suspected that the effects of increasing UV radiation will be an additional stressor to taxa that are already in decline due to the impacts of habitat loss and emerging infectious diseases (Chytrid fungus, ranavirus).

Climate Change and Disease

Climate change predictions, such as thermal extremes and weather disasters, can contribute to:

- Changes in vector and pathogen distribution
- Pathogen emergence
- Altered habitats
- Droughts

The interaction between climate change and disease dynamics in wildlife is complex and as yet poorly understood. Vector borne or environmentally transmitted disease pathogens appear to provide the most convincing evidence that a warming climate may be facilitating their spread. Insect vector species can be sensitive to temperature and precipitation fluctuations and these climatic factors are known to impact life-cycle completion times, biting and feeding rates and overwintering survival of important disease vector species. Expanding ranges allow these vectors to encounter native host populations. Parasites that have a free-living life stage may have their development times and transmission windows impacted by increasing temperatures.

There is an increasing trend of novel or introduced pathogens occurring worldwide. This is significant in part because they can result in rapid and devastating population declines that often pose a greater threat to conservation efforts than habitat loss. Global population declines and extinctions have impacted amphibian species due to the chytrid fungus; white nose syndrome caused by the fungus, *Geomyces destructans,* is threatening the persistence of the little brown bat (*Myotis lucifugus)* in eastern North America; and pneumonia complex in bighorn sheep has caused all age die-offs leading to local collapse and extinction of meta-populations across the western states.

Nutritional stress (decreased calories, protein, vitamins, and other essential nutrients) and dehydration can occur secondary to thermal extremes or drought and may decrease the effectiveness of the immune system thereby lowering disease resistance to known or emerging pathogens. Immunodeficiency resulting from malnutrition has been well documented in humans and is strongly related to increased incidence of infectious diseases and infant mortality worldwide. Nutritional stress may impact other physiological processes in addition to immunity such a growth rate and reproduction leading to potential population impacts in vulnerable species.

Ecological Change and Disease

Ecological changes or shifts caused by climate change, such as land degradation and habitat fragmentation, can cause:

- Decreased food/nutrient availability may have a direct effect such as starvation, dehydration, or nutritional deficiencies may secondarily impact physiological processes resulting in an increased susceptibility to infectious disease.

- Restricted movement of animals due to loss of habitat corridors may isolate populations leading to decreased gene flow, inbreeding, and loss of genetic diversity. This may impact immune system responses and reproductive rates within these isolated populations.

- Increased rates of contact with humans or domestic animals can lead directly to increased pathogen transmission. If domestic species and wildlife are competing for the same decreasing resources at certain periods during the year this may place wildlife at an increased risk of disease. Most domestic livestock receive supplemental feed during part of the year thus their nutritional and physiological needs are met. Wildlife species competing on the range for limited resources may already be in a negative nutritional state with a compromised immune status and thus more vulnerable to disease transmission.

Determining the effects of anthropogenic influences, in particular climate change, on host–pathogen interactions is a challenge as these relationships are already complex. The impact of increasing population densities coupled with decreasing habitat resources are generally felt to facilitate disease transmission; however, some diseases have shown increasing incidence with decreasing population density and, with some interactions, it is believed that host population isolation secondary to the effects of climate change may lead to pathogen extinctions. Isolation of populations of desert bighorn sheep produced by herds moving to higher elevations across their range (as lower elevations are no longer habitable due to a warmer and drier landscape) has been hypothesized as a model of the effects of climate change, leading to a decline in population viability in the face of decreasing disease transmission. Initial concentration of individuals may increase the incidence of disease within the population; however, as metapopulations become increasingly isolated the chance of disease spread between populations declines and certain diseases may not persist.

With the possible exception of desert tortoises and bighorn sheep, extensive surveillance for and documentation of diseases in Nevada's wildlife has not been conducted. Extrapolations from studies conducted on species with ranges that overlap into Nevada (primarily those species along the Sierra Nevada) contribute to the current body of information; however, further efforts are needed to establish a baseline of health data within the state's wildlife populations. Such a baseline of data would assist wildlife managers in defining which components of the epidemiological triad currently influence disease distributions and prevalence in Nevada's wildlife thus increasing the our understanding of which components, impacted by a changing climate, may influence future disease events.

Climate Change

A growing body of evidence has linked changing climate with observed changes in fish and wildlife and their habitats. Climate change has likely increased the size and number of wildfires, insect outbreaks, disease outbreaks and tree mortality in the interior West and Southwest. In the aquatic environment, evidence is growing that higher temperatures are negatively impacting cold and cool water fish populations across the country (USFWS, 2010).

Climate is changing at an accelerated rate and science strongly support the findings that the underlying cause of these changes are largely the result of human–generated greenhouse gas concentration in the atmosphere caused by increasing human development and population growth (USFWS, 2010). Global temperatures are expected to continue to rise through the 21st century, dependent on the continued accumulation of heat-trapping gas emissions and the sensitivity of regional climates.

Average air temperature worldwide has risen steadily over several decades and dramatically since the 1950s. The first decade of the 21st century has proven to be the hottest decade since scientists began recording global temperatures in the 1880s, with the 1990s following close on its heels as the second hottest. In September, 2011, the polar ice cap set a new record low for area frozen at the end of summer, a trend that has been on a downward track for over a decade. Reports from all over the world of glacier melt, disrupted plant community phenological cycles, and disrupted bird migrations continue to mount. The average rate of sea level rise has doubled in just the last 20 years, and projections made just five years ago are already out of date, with actual change more accelerated than predicted.

Rainfall patterns around the world will be affected. Rising temperature causes water to evaporate faster, resulting in more water in the atmosphere. While scientists predict that global average annual precipitation will increase as a result, the increases will not be distributed evenly across the globe. Rainfall in many regions will increase in range of variability. Rain storms will become more intense but less frequent. Also, in some areas snowfall will shift to rain, with major implications for streamflows and seasonal availability of water for wildlife, fish, and people.

As the concern for climate change and its impact grows, federal, state, and local agencies and conservation organizations have been developing guidance documents for wildlife-related climate response. The USFWS developed the document: "*Rising to the Urgent Challenge: A Strategic Plan for Responding to Accelerating Climate Change*", in 2010. The Western Governors' Association published the document, *"Climate Adaptation Priorities for the Western States: Scoping Report",* in 2010. Very recently, the USDA Forest Service released the publication, "*Responding to Climate Change in National Forests: A Guidebook for Developing Adaptation Options"*. In 2011, The National Wildlife Federation published "*Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment".* In addition, a team of federal, state and tribal nations have developed the Public Review Draft of the "*National Fish, Wildlife and Plants Climate Adaptation Strategy",* which should be completed in 2012.

The AFWA/FWS document, "*Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans*", includes recommended steps for developing and implementing adaptation strategies in the face of climate change:

1. Engage diverse partners and coordinate across state and regional boundaries.

2. Take action on strategies effective under both current and future climates.
    - Managers should focus on conservation actions likely to be beneficial regardless of future climate conditions. This can include reducing non-climate stressors, managing for ecological function and protection of diverse species assemblages, and maintaining and restoring connectivity.

3. Clearly define goals and objectives in the context of future climate conditions.
    - Goals and objectives should address whether they aim to resist the impacts of climate change, promote resilience, and/or facilitate changing conditions.

4. Consider appropriate spatial and temporal scales.

5. Consider several likely/probable scenarios of future climate and ecological conditions.

6. Use adaptive management to help cope with climate change uncertainty.

The documents and principles listed above were used as guidance in the development of this revision of the WAP. NDOW also serves on the AFWA and Western Association of Wildlife Agencies (WAFWA) Climate Change Committees to stay updated on national and regional wildlife issues related to climate change.

Climate Change in Nevada

Primarily using the climate change predictive tools available through the Climate Wizard (www.climatewizard.org), the Revision Team led by The Nature Conservancy's vegetation modeling team settled on the A2 Emissions Scenario from the *Climate Change 2007: Impacts, Adaptation, and Vulnerability* report (IPCC, 2007) for climate change modeling. The general deductions made from following the A2 scenario were that Nevada would increase in temperature about 3° C with greater greenhouse gas concentration, but with the same total amount of average precipitation. This prediction is highly dependent on the influence of the Pacific Ocean. The greatest uncertainty for future climate forecasting (high divergence among Global Circulation Models) will be for a western shift of the western boundary for the monsoonal effect (i.e., summer precipitation). For the purposes of modeling vegetation response, it was assumed that the eastern Nevada regions would experience a greater amount of summer precipitation and therefore less drought.

More specific hypotheses of change that developed as a result of our analysis were:

- Increased dispersal of non-native species caused by CO_2 fertilization of plant growth during wetter than average years

- Decreased dispersal of non-native species during drier than average years regardless of CO_2 concentrations

- Higher tree mortality during longer growing season droughts

- Longer period of low flows caused by earlier snowmelt
- Greater severe flood variability due to greater frequency of rain-on-snow events, which would favor cottonwood and willow recruitment on currently regulated rivers and creeks
- Longer period of groundwater recharge during colder months with low evapotranspiration and greater percentage of rain *versus* snow (more effective recharge)
- More stable discharge (buffered from precipitation) for springs, seeps, wet meadows, creeks, and rivers on carbonate geology and, conversely, less stable discharge on non-carbonate geology
- More frequent, larger fires in forested systems
- Increased growth and recruitment of subalpine trees due to increased tree line temperature regardless of CO_2 fertilization
- Longer fire return intervals in shrubland systems due to increased drought frequency preventing fine fuel build up
- Greater conifer and deciduous tree species recruitment and growth in wetlands/riparian due to drought and CO_2 fertilization
- Impaired recruitment of willow and cottonwood due to descending peak flows occurring one month earlier and limited ability of these species to flower one month earlier in cold drainages; and
- Faster growth of fast-growing native tree species.

Compared to scenarios without climate change, the climate change effects predicted over the next 50 years yielded consistent differences that resulted in both detrimental and beneficial ecological responses that varied by region; therefore we were able to conclude that climate change would contribute specific impacts over and above the natural rate of change assisted by other human-induced impacts.

Energy Development

The status of our current economy has had great influence upon land use within Nevada. Nevada with its large percentage of public land makes it a good choice for the purposes of developing an infrastructure for renewable energy. This development is being viewed as a means of diversifying our state's economy, a source for new job creation and as a native source for renewable energy production. Nevada has great potential for both solar and geothermal energy production and to a lesser degree, wind and biomass energy development. Each of these energy resources rely upon characteristics at a specific location (whether its sunlight intensity, consistent wind, or geothermal heat sources) that make a location desirable for development. The viability that makes these locations "work" for development includes its access, its proximity in relation to the electric grid, and the ease of which that site could be developed. That ease depends upon land ownership, zoning, or land designation for development and the ability to overcome or compensate for the environmental constraints of the site.

It has been well documented that energy projects have the potential to result in a loss of wildlife habitat (both permanent and temporary), habitat fragmentation and a host of indirect impacts such as disturbance created by human activity, vehicle traffic, noise, and noxious/invasive weed introductions. Technology has developed to treat many of these constraints and the success of reclaiming for the temporary loss of habitat has certainly made great advances. Yet the constraints are real, political decisions sometimes outweigh the need to make the best environmental decision and the challenges to wildlife conservation remain.

The best tool that land and resource managing agencies have is a detailed and current database of the resources that may be impacted by energy development. NDOW and NNHP have over the years worked on the development of GIS databases that provide spatial information on the resources. These data are used in a series of models that analyze management schemes and priorities for protection. In regards to energy development, the spatial information is used to aid in the siting of facilities and for comparing project alternatives.

Agencies have been stressing the importance of applying wildlife resource data in the siting of proposed facilities in an attempt to avoid high quality habitat and large undisturbed areas. The priority for land use would be to site on already disturbed ground, to site new facilities near existing facilities, and to avoid priority wildlife habitat. Unfortunately, not all projects request or use the resource data soon enough in the development of their plans to apply avoidance even though NEPA requires its application as the first effort in minimizing the impacts of development

Challenges for Wildlife Conservation

- Encouraging developers to use wildlife resource data early enough in the process to influence facility siting to avoid high quality wildlife habitat
- Developing and updating best management practices as mitigation to address potential impacts from energy projects and their changing technology
- Conducting sufficient research and pre-construction monitoring to best assess the impacts of energy development on wildlife
- Identification of sufficient project location alternatives to avoid impacts of concern
- Identification of high value wildlife habitat for avoidance and to identify areas of low quality wildlife habitat as opportunities for development
- The ability to identify areas unaffected by future proposed projects for application of offsite mitigation
- Ability to receive compensation for the loss of habitat which could take many years (sometimes upward of 25 years in sagebrush habitat) to recover to pre-disturbance conditions
- Ability to prevent the establishment of invasive plant species, particularly noxious weeds, from becoming established in areas where soils have been disturbed
- Ability to prevent wildlife mortality, in toxic evaporation or cooling ponds and other water impoundments
- The ability to avoid habitat fragmentation caused by linear projects incorporating new roads, powerlines, or pipelines
- Planning for the closing, termination or cessation of energy projects, the removal of facilities, and other decommissioning actions and site restoration activities

Actions Associated with Energy Projects to Advance Wildlife Conservation

- Programmatic Environmental Impact Statements which have addressed the issues common to energy development on Public Lands in a general sense and have identified some of the issues which are common to those projects. Those documents include: Wind Energy Development PEIS, Geothermal Energy Development PEIS and the Solar PEIS
- Guidelines developed by the USFWS for the siting of Wind Energy Development Projects
- Guidelines, Recovery Plans, and Habitat Protection Plans developed for specific species or habitats to identify or require protection including: Guidelines for Golden Eagles, and Greater Sage Grouse, the Clark County Multiple Species Habitat Protection Plan, to name a few
- Issuance of the Standards for Energy Development in Sage Grouse Habitat by the Governor's Sage Grouse Committee
- Development of standards and best management practices to reduce predation by aerial predators utilizing high voltage electric transmission lines including application of anti-perching and anti-nesting devices
- Guy wire covers and other anti-collision devices which make guy wires and static wires more visible to reduce bird collisons
- Studies funded by project developers which increase the science of how wildlife reacts to energy developments. The Falcon to Gondor 345kV Project funded sage grouse study has provided some essential interaction and behavioral data

Direct Human Effects

Another anthropogenic effect and source of stress is direct negative human interaction with wildlife, specifically, overexploitation of species through illegal activities such as poaching, illegal collection or killing, excessive harvest of species for commercial or scientific research purposes, and habitat destruction associated with collection activities. Although difficult to demonstrate in a quantitative sense, such activities have the potential to present significant threats at a local level, particularly for rare and geographically isolated Species of Conservation Priority.

Grazing

Livestock grazing on the Nevada range has a long history and remains one of the state's important industries. Livestock managers make and implement grazing management decisions to achieve a variety of goals, including profitable livestock production, keeping working ranches and farms in the family, and wildlife habitat enhancement. Grazing management plays a pivotal role in the quality and extent of wildlife habitat. Livestock grazing is the most widespread activity overseen by federal land management agencies in Nevada and affects a large portion of the Nevada landscape.

Livestock grazing now competes with more uses than it did in the past, as other industries and the general public look to public lands as sources of both conventional and renewable energy and as places for outdoor recreational opportunities, including off-highway vehicle use. This competition for land use is a sign of the times across the West, and debates over livestock and wildlife values should be placed within this broader context. Ranchers and wildlife conservationists know that debates over grazing and animal management units (AMUs) are of little importance if rangelands continue to be lost, degraded, or fragmented because of development, the dominance of exotic species, catastrophic wildfire, or restructuring of water allocations. Still, domestic grazing that reduces land values via reduced productivity and habitat quality can also lead to habitat conversion, alternative land uses, and suspension of permitted leases for not meeting minimum land health standards.

With increased use of public lands, wildlife is increasingly coming into contact with ranching and farming operations which may lead to neutral, beneficial or incompatible interactions depending on the type and magnitude of interaction.

Grazing management was initially designed to increase productivity and reduce soil erosion by controlling grazing through both fencing and water projects and by conducting forage surveys to balance forage demands with the land's productivity ("carrying capacity"). Over time, public expectations for the management of public lands continues to rise and includes new challenges such as: global climate change, severe wildfires, invasive plant species, and dramatic population increases, including associated rural residential development. These challenges add to the management challenges for both wildlife and livestock grazing.

Consequently, livestock grazing has shifted management objectives and priorities over the years to better manage and conserve specific rangeland resources, such as riparian areas, threatened and endangered species, sensitive plant species, and cultural or historical objects. Currently, grazing is managed with the goal of achieving and maintaining public land health using rangeland health standards and guidelines that were developed in the 1990s with input from citizen-based Resource Advisory Councils across the West.

Livestock facilities such as springs developments, water pipelines, and fencing have distributed livestock use over areas that were sporadically or lightly used prior to agricultural development. Distribution of livestock over a greater area, can also reduce impacts associated with concentrated livestock – trampling, soil compaction, eroding trails, etc. Water diversions (surface or excessive ground water withdrawal) are the most common threat to fish and other aquatic species in Nevada. Water diversions create functional changes in the spring system by decreasing water volume and reducing soil moisture. Riparian vegetation can be affected when excessive groundwater withdrawals lower the water table.

The loss of natural water resources threatens wildlife, but domestic livestock also require water to survive. Since the advent of commercial grazing on rangeland, ranchers have improved existing water supplies and developed new water systems for their livestock. Wildlife managers also develop water resources specifically for wildlife, and increasingly, livestock and wildlife water developments replace or augment diminishing natural sources in many areas and have become crucial for many species, especially during times of drought or unseasonably high temperatures. The presence of livestock water developments can also improve the quality of surrounding habitat, allowing wildlife species to expand into previously unoccupied areas. Pronghorn antelope generally require permanent water sources at intervals of less than five miles within their home range. Ranchers have become increasingly interested in, with the help of various federal programs, developing water systems that are wildlife friendly (e.g., wildlife escape ladders, using structures of different size, shape or position to enhance wildlife use). Strategically placed water developments that are managed to eliminate excessive diversion and that incorporate wildlife friendly features can be used to enhance rangeland for both livestock and wildlife.

Grazing has positive or negative effects depending on current and historic timing and intensity of grazing, soil conditions, precipitation, plant communities, and specific habitat (e.g. riparian) features under consideration.

Fortunately, habitat needs of many wildlife species are known and these requirements provide the “sideboards” necessary to develop guidance for grazing strategies for maintaining or enhancing wildlife. Food, cover, and space are habitat needs for both wildlife and livestock. Grazing management can be focused to managing livestock in a manner that supports these basic habitat elements while maintaining native plant community integrity – the plant communities to which native wildlife have adapted.

Invasive Species

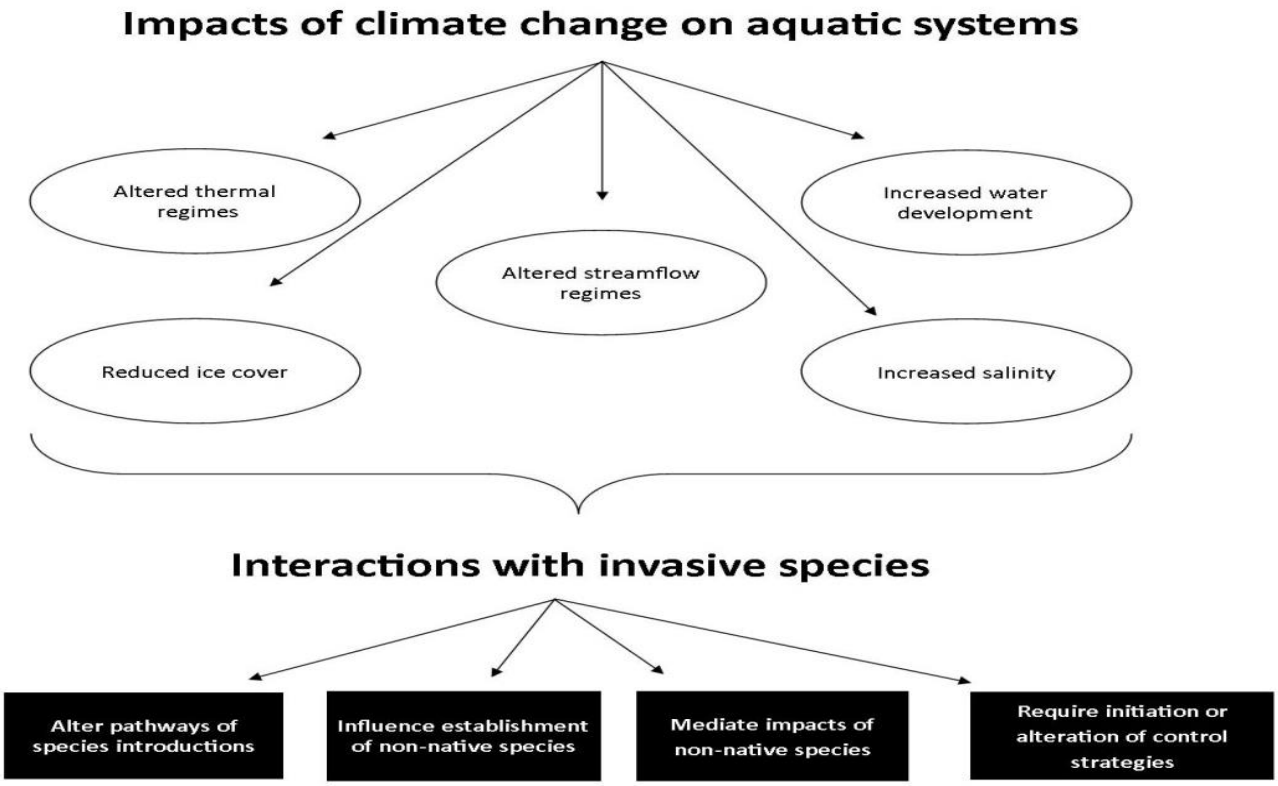
A number of other sources of stress for wildlife and habitats exist and are not well connected to land use per se, but are primarily of human origin. Invasive, exotic, and feral species are one of the most significant and difficult problems facing both terrestrial and aquatic species and habitats in Nevada. These non-native species, through their invasive natures can outcompete native species and decrease the complexity of the native ecological communities, thus contributing to localized loss of species and overall reductions in wildlife diversity. They can also alter natural ecological processes through changes in fire regime, resulting in self-sustaining exotic communities with little prospect of restoration back to natural communities or stability in naturally dynamic and changeable aquatic habitat substrates. The presence of exotic animal species can disrupt natural community dynamics through competition for resources, and can cause direct conflict and predation resulting in displacement, mortality and extirpation of native species. Invasive and exotic species can introduce alien diseases into non-resistant native populations.

Aquatic Invasive Species

Non-native species that have been intentionally or unintentionally released into new environments can become aquatic invasive species, causing environmental, economic, and human health harm (EPA, 2007). The National Invasive Species Council defines an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” It should be noted, however, that not all non-native species are harmful or will become invasive. For example, it has been found that 28% of non-indigenous fishes have had beneficial effects (OTA, 1993; EPA, 2007). For those species that do become invasive and cause ecological and/or economic damage, their impact can be devastating to an ecosystem. Invasive species are considered a major cause of extinctions worldwide accounting for 25% of fish extinctions, 42% of reptile extinctions, 22% of bird extinctions and 20% of mammal extinctions (Cox, 1999; EPA, 2007). In the U.S., damage and losses from invasive species are estimated to be valued at approximately $120 billion annually (Pimentel et al., 2005). Aquatic invasive species (AIS), in particular, can have a wide range of ecological impacts including loss of native biodiversity, altered habitats, changes in water chemistry, altered biogeochemical processes, hydrological modifications, and altered food webs (EPA, 2007).

Evaluating the relationship between AIS resulting from changes in climate is relatively unknown and research needs to be conducted to clarify the impact. However, generally accepted changes are expected to impact aquatic systems in several major ways including increasing water temperatures, altering stream flow patterns, and increasing storm events (Poff et al, 2002). These changes will have profound impacts on aquatic ecosystems including altered thermal regimes, reduced ice cover, altered stream flow regimes, increased salinity and increased water development activities. Aquatic ecosystems and their respective organisms will be vulnerable to a changing environment and in many cases open the door for new introductions and increased spreading of AIS. Figure 3 (Rahel, Frank J. et al., 2008) depicts characteristics of aquatic systems that will be altered by climate change and how these changes will affect AIS.

Figure 3. Characteristics of aquatic systems that will be altered by climate change (Rahel, Frank J. et al., 2008)



Climate change is expected to alter the thermal regimes of much of the Earth's surface resulting in increased water temperatures. As the water warms, it is expected that warm-water aquaculture, tropical fish culture, and outdoor water gardens will expand providing new opportunities for unintentional AIS introductions that are capable of becoming established in historically colder water systems (Rahls, 2007). Suitable thermal habitat for warm-water fishes is predicted to increase by 31% across the U.S. due to climate change (Mohseni et al., 2003, Rahls et al., 2007). In addition, climate warming is predicted to allow for expansion of invasive coldwater species into new areas. For example, native bull trout have a competitive advantage over non-native brook trout in the "coldest" streams in the Rocky Mountains. As these streams warm, brook trout are expected to achieve competitive superiority and thus displace native bull trout from their habitat (Rahls et al., 2007).

Climate change is also expected to reduce the extent of ice cover on lakes which may influence the invasion process by increasing light levels for aquatic plants, reducing the occurrence of low oxygen conditions in winter, and thus exposing aquatic organisms to longer periods of predation from terrestrial predators (Rahl et al., 2007). In addition, the loss of winter hypoxia could also foster the expansion of quagga and zebra mussel populations in cold water lakes whereby the habitat would become more suitable for AIS establishment and rapid reproduction.

Climate driven changes to the flow regime is expected to influence the magnitude, frequency, duration, and timing of floods, droughts, and intermittent flows that are the primary drivers of ecological structure and function in aquatic ecosystem (Poff et al., 1997). Increases in flood conditions could increase the frequency of escapes from aquaculture during overflow events and also increase the dispersal of AIS through transportation through flooded streams (Havel et al., 2005; Rahl et al., 2007). During drought conditions, AIS (e.g., such as New

Zealand mud snails) can tolerate frequent and prolonged droughts and are tolerant of desiccation, thereby striving in harsh environments. Freshwater fish with opportunistic life-history strategies such as mosquito fish, guppies, and red shiners are also likely to increase in distribution and abundance (Olden et al., 2006; Rahl et al., 2007).

As the climate changes, arid regions are expected to experience increases in desiccation and alter the salinity of freshwater ecosystems (Seager et al., 2007). In addition, increases in water diversion and withdrawals that can provide new and altered pathways of introduction of AIS. Shifts are expected to occur due to salinity and increased water development activities that could lead to a decline of native fish species and the proliferation of invasive species that are salt and drought tolerant. Salt tolerant species such as red shiner, western mosquitofish, plains killifish, and invasive plant species (i.e, salt cedar) could successfully establish and dominate in the changed environment.

Identifying, preventing and eradicating AIS threats in a changing environment will require diligent state management and response plans that are capable of changing as the climate and AIS threats change. In addition, climate change impacts to existing or threatening AIS in Nevada will require additional research and site specific assessments. The ability of aquatic ecosystems to adapt to climate change is also limited in that expected rates of climate change are probably too great to allow adaptation through natural genetic selection and many types of habitat will be diminished or possibly lost entirely (Poff et al., 2002). In addition, human activities in response to climate change have the potential to severely modify many aquatic ecosystems. AIS species already established in Nevada, such as quagga mussels, Eurasian milfoil, Asian clams, and curly leaf pondweed, in addition to newer threats, such as Asian carp and other warm-water fish and plant species, will more than likely have the potential to spread into new habitat and regions within the state as water temperatures increase.

Terrestrial Invasive Plants

Invasive plants, such as noxious weeds, have become a major ecological and environmental concern throughout Nevada over the last couple decades. Noxious weed species are species that have been identified by the State of Nevada as plant species that are "injurious to the environment, economics, and public health." Some of more prevalent noxious weed species include tall whitetop (perennial pepperweed), tamarisk (salt cedar), yellow starthistle, various noxious thistles, several knapweed species, including Russian knapweed, and annual invasive grasses, such as medusahead rye. Other invasive plants, such as cheatgrass and red brome, are equally as threatening to native plant communities but are not officially designated as "noxious" because of these species prevalence and inability to achieve complete eradication.

Medusahead rye has increasingly expanded its range throughout northern Nevada over the last five years. Range landscapes, particularly in the Santa Rosa Range, Humboldt sink, Carson Range, and Washoe County, have become invaded with this species. Several factors make medusahead extremely competitive. It produces many seeds that germinate quickly year round. It also has roots that grow in winter. The plant litter is slow to decompose due to this plant's ability to uptake silica from the soil and this inhibits seedlings of other plants. This litter also creates fuel for intense, damaging fires.

There are many tools in the "integrated plant management" toolbox; however, one of the greatest tools that can be used against invasive plants is early detection, rapid response (EDRR). EDRR can be utilized by land and resource managers to quickly identify invasive plant expansion or newly invading plants. Once a species has been identified, immediate response (i.e., weed treatment or removal) shall be conducted to expeditiously eradicate and remove the plant from the location. Prevention is key to effective invasive species management; therefore, EDRR is an exceptional tool for the long-term management of invasive plants in Nevada.

Land Development

Until recently, Nevada was one of the fastest growing states in the nation in human population, and both the Reno and Las Vegas metropolitan areas far exceeded average values for population growth, creating a concurrent need for additional development into existing open space and supporting urban infrastructure. Urban and suburban development, even when well controlled and regulated, cause permanent habitat loss and conversion; direct mortality of wildlife attributed to construction; habitat fragmentation and increased erosion; and sedimentation and nutrient or toxin loading associated with urban runoff. Right-of-way fences associated with roads interrupt wildlife movements and contribute to direct wildlife mortality. Important secondary effects of the urban/wildland interface can include increased local recreation from motorized and non-motorized sources, negative interactions between pets and wildlife, and increased potential for the spread of exotic species and illegal woodcutting. Existing landfills subject to the burdens of increased urban populations can result in local soil and groundwater contamination and unnatural support for generalist predators (e.g., corvids, gulls). Largely associated with urban and suburban development, industrial development creates many of the same potential stresses, including habitat loss and fragmentation, and soil or groundwater contamination from improper disposal and discharge of toxins and hazardous materials. To the degree that such impacts cannot be adequately regulated, airborne pollutants and nutrients can reduce habitat structure, composition, and quality.

Outside of areas of significant urban or suburban development and their wildland interfaces, effects associated with development have been and will continue to be problems for wildlife and habitats. Utility rights-of-way and associated developments such as wind energy farms can cause mortality through collisions and electrocutions. Habitat alteration follows facility and road construction, operation, and maintenance. Direct effects to wildlife may occur through disturbance and alteration of behavior and movement patterns. Infrastructure also provides more perch sites for avian predators in sensitive areas (e.g., desert tortoise habitat and sage grouse strutting grounds). Rights-of-way can serve as conduits for invasive species.

Road development, both in association with development projects and as a stand-alone independent effect, can cause habitat fragmentation, direct mortality, and disturbance of wildlife, and impacts from runoff including erosion, sedimentation, and contamination. The improper placement of road developments in riparian corridors and meadows can compound the core effects of this activity, and roads of any kind serve as conduits for invasive species.

Military Activities

Nevada has a lengthy history of assistance to the nation’s military and its mission, in particular because of the availability and access to broad areas of public lands for military training, maneuvers, and testing. Military installations in Nevada are closed to most non-defense related land uses (that have resulted in conservation of key habitats elsewhere), and thus serve as potential reference areas for ecological studies (e.g., Mt. Grant on the Hawthorne Army Depot, reptile studies on the Nevada National Security Site, formerly Nevada Test Site). Defense-related activities, however, also come with an associated cost and are potential sources of stress to wildlife habitats that may include habitat alteration at target sites and military training areas, habitat modification from facilities construction and maintenance, and soil or groundwater contamination from mission and infrastructure by-products. However, the exclusion of the public on military lands does allow for the property to act as a refuge for wildlife.

Mining

Resource extraction for minerals and non-minerals has a rich history in Nevada and remains one of Nevada's premier industries. Historic mining predominantly involved the excavation of subterranean shafts, adits, and tunnels that left minimum impact on surface habitats, but opened up extensive new habitats underground. Dating as far back as the 1850s, these underground areas have been populated by wildlife, most notably used as roosts, maternity areas, and hibernacula for many of Nevada's bat species. Since their abandonment, the openings of these underground workings pose significant risk to human safety if left unprotected. To relieve the concerns of public safety, many mine openings have been closed with earthen fill. When this permanent closure technique is implemented without an assessment of the value of the underground wildlife resource, serious losses can occur.

Today's open-pit mining techniques leave a much more significant footprint on the surface landscape. The habitat present before a mine pit is excavated is lost temporarily or permanently and wildlife that lived on the site are temporarily or permanently displaced. Mining companies strive to implement the latest, most aggressive reclamation techniques, but even under the best of circumstances are often only able to stabilize the site in a permanently altered state. There remains considerable opportunity for collaboration between biologists and reclamation engineers to incorporate innovative, yet realistic wildlife goals and objectives into reclamation design based on each site's reclamation potential.

Recreational Activities

The characteristics and extent of recreational activities vary tremendously across the spectrum of Nevada's wildlife habitats, dictated by factors such as access and proximity to urban development as well as the aesthetic appeal of individual habitat types to recreationists. Stresses include wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction. Recreational participants can act unknowingly as conduits for weed invasion. Motorized recreation, including off-highway vehicles, snowmobiles, watercraft, and other devices can result in noise disturbance to wildlife, thus affecting movements, behavior, and reproductive success. Improperly operated, these vehicles can accelerate erosion, and accelerate the invasion of weeds. In particular, improper operation in sensitive areas at the sensitive times of year (e.g., during the snowmelt season), or in desert washes, have potential to cause significant damage. Even non-motorized recreation, activities such as trail development, hiking, mountain biking, horse riding, cross-country skiing, rock-climbing, and spelunking, can cause habitat fragmentation and disturbance to wildlife. Although physical recreation development, for projects such as ski areas, snow parks, developed campgrounds and day-use areas, boat access, and organized event staging areas are likely not a large-scale source of stress across Nevada, these types of actions can cause localized disturbance from human activity and result in soil compaction and vegetation loss.

Timber Harvest

Nevada's forest resources are not extensive and must be managed carefully to achieve the many objectives expected of them. Improper forestry practices and management can create significant stress from actions such as tractor logging on steep slopes, resulting in accelerated erosion and sedimentation; the alteration of wildlife habitat including insufficient habitat structure left after timber harvest (e.g., old growth stand characteristics, snags, dead and down woody material); loss of species and stand age diversity; increased vulnerability to insect outbreaks creating self-sustaining second-growth stand characteristics; inappropriate timber harvest in stream environment zones (subjecting these zones to modification processes); and unauthorized or excessive wood cutting.

Water Management or Water Resources

Throughout Nevada, water is a scarce and valuable resource essential for both human needs and the maintenance of wildlife and their habitats, thus the development and alteration of hydrologic resources is a significant source of stress to wildlife resources. The development and operation of dams and impoundments at all scales, ranging from major reservoirs on the Colorado River to small-scale impoundments for water storage and flood control throughout the state, is an obvious human-induced change to the landscape. These structures modify hydrologic regimes and interrupt natural flow dynamics that result in modified channel and floodplain processes both upstream and downstream from dams and their impoundments. Dams play a key role in the fragmentation of aquatic habitats and modify the nature of both aquatic and terrestrial habitats through inundation upstream and de-watering downstream, frequently creating conditions more favorable to non-native plant and animal species.

Channel modification to lotic (flowing water) aquatic systems, through ditching, diking, and diversion is another significant source of stress to wildlife resources. The effect of these activities on aquatic and associated riparian habitats may include loss or modification of substrate diversity and structure, loss of streambank vegetation and increasing risk of erosion, loss of connectivity between channel and floodplain and within lotic systems by creating barriers to later movement by aquatic species; and actual dewatering and desiccation of aquatic habitats, which can cause direct mortality, reductions in habitat availability, and fragmentation or loss of connectivity within or between aquatic systems.

The development of springs and seeps, a common historic practice for livestock watering, domestic water supply and other purposes, is of concern, given the critical importance of spring resources widely distributed across Nevada's landscape as sources of surface water for terrestrial wildlife, and also because many springs and seeps of all sizes support unique endemic aquatic biota. The development and modification of spring sources and source pools directly alters or removes important aquatic habitats; modifications can limit access to remaining surface water by wildlife; and the diversion of water away from outflow channels can modify, reduce, or destroy associated riparian and wetland habitat, as well as limit or eliminate flowing water habitats for endemic species associated with springbrooks.

Although not directly related to the development and alteration of spring systems, groundwater development has been a historic source of stress for Nevada wildlife and habitats and continues to represent a significant ongoing problem. As demonstrated in areas such as Ash Meadows and Pahrump Valley in southern Nevada, excessive groundwater withdrawal can alter groundwater flow and recharge patterns, resulting in loss of connectivity between groundwater and surface water habitats and concurrent impacts to plant communities and surface flow of groundwater from springs and seeps. These effects are often not well understood and can vary considerably depending on local geology, the characteristics of groundwater development actions, and the nature of the groundwater resources being accessed.

Wild Horse & Burro

Background

In passing the Wild Free-Roaming Wild Horses and Burros Act of 1971 (WFRHBA) (Public Law 92-195), Congress found that “Wild-free roaming wild horses and burros are living symbols of the historic and pioneer spirit of the West.” The WFRHBA further states that wild free-roaming wild horses are to be considered in the area where presently found, and as an integral part of the natural ecosystem.

At the time of the passage of the WFRHBA, herd areas (HA’s) were established for BLM-managed lands with known populations of wild horses. Herd Management Areas, or HMAs, were established later for those HA’s through a land use planning process that set the initial and estimated herd size that could be managed while still preserving and maintaining a thriving natural ecological balance and multiple-use relationships for the area. To be designated as an HMA, the area must have four essential habitat components including forage, water, cover, and space (BLM, 2010). The allocation of forage for wildlife, wild horses, and livestock was established, which set the Animal Unit Months (AUMs) for each category. An AUM is the amount of forage necessary to maintain one adult horse for one month (about 800 pounds of air dried forage) (BLM, 2010).

Management Actions and Constraints

The Secretary of the Interior was directed to “manage wild free-roaming wild horses and burros in a manner that is designed to achieve and maintain a thriving natural ecological balance on the public lands.” Program emphasis has recently shifted management from a removal of excess animals and adoptions to actions that include: increasing fertility control, reducing population growth rates, adjusting sex ratios and collecting genetic baseline data to support genetic health assessments.

The Wild Horse and Burro Program has also shifted management objectives and priorities over the years to better manage and conserve specific rangeland resources, such as riparian areas, habitats for threatened and endangered species, and sensitive plant species. Similar to requirements set forth for livestock grazing, HMAs are to be managed with the goal of achieving and maintaining public land health by achieving and maintaining rangeland health standards and guidelines.

NV BLM manages 85 HMAs covering 14.7 million acres for a statewide Appropriate Management Level (AML) of approximately 12,700 wild horses and burros. Nevada has a current population estimate of 19,000 to 21,000 wild horses and burros not including foals born in 2011. Over the last five years (2007-2011), NV BLM has maintained an average population size of roughly 17,000 wild horses and burros based on average annual removals of excess animals of nearly 3,800 statewide.

Within the program spending, the holding and care of excess wild horses and burros accounted for nearly 75% of that budget, with the balance directed at on-the-ground management, gathers and preparing horses and burros for adoption, sale, or placement on long-term grassland pastures.

Since 1971, approximately 230,000 wild horses and burros have been adopted. The number of animals that have been removed from the range for management purposes far outweigh adoption and sale demand. Last year, adoptions fell below 3,500 animals, down from an average of 6,300 per year in the 1990s. The decline in adoptions and sales can be contributed to the current weak economy and large numbers of available domestic horses as well as a shift towards a more urbanized culture.

On-the-Ground Management

A variety of management practices have been in use since the passage of the WFRHBA. The BLM’s goal is to ensure and maintain healthy wild horse populations on healthy public lands. To do this, the BLM works to achieve the AML – the point at which wild horse and burro herd populations are consistent with the land's capacity to support them.

1. Population Inventory

The BLM needs population estimates to determine whether and where excess wild horses and burros exist, and, if there is an excess, how many animals need to be removed from public rangelands. Population estimates also guide the BLM in applying fertility control to mares and adjusting herd sex ratios in favor of stallions or geldings to reduce on-the-range births. The BLM works to ensure that horse populations are in balance with other rangeland resources and authorized uses of the public lands.

Most BLM field offices base their population estimates on the counting of each wild horse and burro actually seen during direct counts from either a helicopter or fixed-wing aircraft. In addition to collecting information about the location and condition of herds within HMAs, the BLM compiles basic data about the land, such as the amount and quality of forage and the availability of water.

2. Population Growth Suppression

Under the WFRHBA, the BLM is required to maintain herd populations at AMLs and protect the range from deterioration from overpopulation. The BLM is directed to determine whether AMLs should be achieved by removal or humane destruction of excess animals or other options (such as sterilization or natural controls on population levels). In order to reduce or limit population growth rates the BLM has begun investigating and researching several possible growth rate suppression techniques.

a. Contraception

The BLM has supported the development of an effective contraceptive agent for wild horses since 1978. Currently the most promising agent is a vaccine known as porcine zona pellucida (PZP) that was developed in the 1990s. The BLM uses PZP under an investigational new animal drug exemption issued by the Food and Drug Administration and held by The Humane Society of the United States (HSUS).

The most effective is a one-year liquid vaccine that must be re-administered annually. However, it is not feasible to gather wild horse herds every year to administer this form of the vaccine. The BLM uses the longer lasting 22-month pelleted PZP agent (PZP-22). Maximum effectiveness of PZP-22 is achieved when the mares are treated during a three- to four-month window prior to foaling.

Since 2004, the BLM has administered the pelleted PZP vaccine to more than 2,800 mares on 79 of its 179 HMAs, but significant reductions in the rate of population increase have not yet been apparent. Analysis of data from the McCullough Peaks herd, which was treated in 2004, indicates that treated mares had an average foaling rate of 32% in the two years following treatment, compared with a 75% foaling rate in untreated mares.

b. Sex Ratio Adjustment

One way to potentially slow population growth and extend the time between gathers in wild horse herds is to adjust herd sex ratios to include more males than females. BLM rangeland managers can use this option following a gather by releasing more stallions or geldings than mares back to the range. The larger proportion of males mean there will be fewer mares in the breeding population, resulting in fewer births. Sex ratio adjustment is mostly applicable to larger HMAs and is also most practical after the AML has been achieved.

c. Sterilization

Consistent with the WFRHBA's mandate and authority, the BLM can apply temporary or permanent sterilization to decrease herd growth rates while maintaining a herd's ability to sustain itself. When implementing this type of population growth suppression, animals can be captured, sterilized, and returned to the range. Castration (gelding) is a safe, effective, humane, and efficient method of sterilizing stallions. For this reason, the BLM is beginning to return geldings to HMAs in the place of mares to reduce the number of breeding mares within the population.

Spaying and other means of sterilizing mares are being considered by the BLM but has not been applied as a management tool on the range.

Impacts to W ldlife and their Habitat

Wild horse and burro populations that have increased over the upper limit of the AML can have long-term adverse effects to wildlife resources. By achieving and maintaining appropriate population levels, the health of the rangeland resources used by wildlife would be protected from habitat degradation associated with wild horse overpopulation. Reduced competition for forage, water, cover, and space would provide diverse plant communities that meet applicable life cycle requirements for all wildlife species. Unfortunately, many of the herds currently exceed the upper limit of AML.

The overall impact wild horses and burros have on any type of ecosystem depends on intensity and duration of use, timing, and the health and resilience of the area. Plant diversity can decrease and habitat structure can be altered if the AML is exceeded over time and vegetation and water sources are over-utilized (Beever & Brussard, 2000). A less diverse plant community can be vulnerable to wildfire and invasive grasses such as cheatgrass. Cheatgrass displaces native perennial plants by germinating earlier and quicker. It is also adapted to frequent fires perpetuated by the fine fuels it creates. Beever et al. (2008) studied vegetation response to removal of wild horses and found sites without wild horses had greater shrub cover, total plant cover, plant species richness, and native grass cover than sites with wild horses.

Wild horses will use areas that have more grasses because they are primarily grazers. Sage-Grouse habitat can be adversely affected if grasses are over-utilized because horse populations are above the AML. Sage-Grouse require specific amounts of grass cover for optimal nesting habitat, an abundance of forbs for brood-rearing habitat, and water with sufficient vegetation to support insects and to provide cover (Connelly et al., 2000). Decreased cover and diversity of grasses and shrubs as well as decreased mammal burrow density have been documented at water sources used by wild horses (Beever & Brussard, 2000; Ganskop & Vavra, 1986). Small mammals are prey for many species and less prey could negatively affect raptors and carnivores that inhabit the area.

Nevada is the driest state in the U.S. and water resources are critical to the existence and management of all species. Year-round use of riparian areas by wild horses and burros can result in long-term or permanent habitat impacts through soil compaction and increased erosion as well as impacting water quality and quantity. Furthermore, wild horse and burro competition for limited water at seeps and springs during the critical hot summer months can have a significant impact on native wildlife. Wild horses and burros tend to have a dominant status within in the social interactions at these watering areas. Though there may not be aggressive behavior between wild horses and burros, deer, and bighorn sheep, their mere presence at these limited sources may affect the distribution of native species and their use of the habitat.

Wildland Fire

Wildland fire is a natural process and plays an important role in the creation and maintenance of Nevada's terrestrial habitats and vegetative communities. Fire plays an important role in the restoration and management of those communities and habitats; however, fire management must be implemented with full consideration of all of its aspects and consequences. Improperly applied, fire suppression has altered natural ecological processes through the build-up of fuels; increased risk of catastrophic wildfire resulting in permanent loss of habitat values; accelerated conversion to alien plant communities; increased erosion and sedimentation; and increased fire frequency and spread of self-sustaining non-native communities. Further community-level effects can include the disruption of successional cycles; the unnatural maintenance of successional stages and vegetation structure and condition; and tree community encroachment into shrub and grassland habitats. Improper fire restoration policy can compound the effects of fires and fire suppression, through exotic plant introductions from seed mixes, improper early grazing access to restored areas, and inadequate response to post-fire restoration needs, including "no action" after a fire. Finally, while the application of prescribed fire to maintain habitat health is appropriate and necessary in certain situations, this land management technique must be applied with irrefutable knowledge of the fire history of the habitat type, its response mechanisms and fire return interval. Misapplication of prescribed fire in habitats where these characteristics are misinterpreted or not well-understood can have irrevocable impacts on the landscape. All in all, the discussion of applying prescribed fire to the landscape is a sensitive topic in Nevada and it is important that management theory, design, and implementation be carried forward by consensus with full participation of all stakeholders.

Ruby Mountains Photo Courtesy of R. Wilson

Identification of Species of Conservation Priority

Climate Change Vulnerability Assessment of Conservation Priority Species

Overview of the NatureServe Climate Change Vulnerability Index (CCVI)

The Nevada Natural Heritage Program (NNHP) assessed the relative vulnerability, and the relative importance of factors contributing to that vulnerability, for Nevada's Species of Conservation Priority (SOCP) using the NatureServe Climate Change Vulnerability Index (CCVI). The CCVI was chosen for this project for a number of reasons: 1) it was designed as a rapid way of assessing a large number of species in a relatively short period of time; 2) it is cost-effective (free tool provided by NatureServe); 3) it is packaged as a programmed Excel workbook and is easy to use; 4) it was not overly technical; it was designed to be used by any person with a science background; and, 5) the results are presented in a way that allows the user to group taxa by their relative risk or by specific sensitivity factors, which helps direct management and adaptation.

The CCVI uses a scoring system that integrates a species' predicted *exposure* (direct and indirect) to climate change within the assessment area (i.e., the state of Nevada) and a series of factors, all supported by published studies, associated with a species' *sensitivity* to changes in climate. The tool also incorporates documented or modeled response to climate change, if available. The tool weighs each sensitivity score depending on the magnitude of projected climate change, incorporates any documented or modeled responses, and calculates a final vulnerability index score.

Direct exposure is the magnitude of projected temperature and moisture change across the species' range within the assessment area. For this project, direct exposure was measured using climate data obtained from The Climate Wizard. The Climate Wizard uses base climate projections previously downscaled by Maurer et al. (2007). As recommended in NatureServe's Guidelines for Using the NatureServe Climate Change Vulnerability Index (Young et al., 2011), a mid-century time line, Medium A1B emissions scenario, and ensemble average of 16 general circulation models were used for the species' vulnerability assessments. Predicted moisture changes were based on the Hamon AET:PET Moisture Metric, also developed by The Climate Wizard team. This metric integrates temperature and precipitation through a ratio of actual evapotranspiration (AET) to potential evapotranspiration (PET) with consideration of total daylight hours and saturated vapor pressure (Young et al., 2011).

Indirect exposure includes phenomena such as sea level rise (not a factor in Nevada), the presence of natural and/or anthropogenic barriers that would hinder or prevent a species from dispersing to a new area with a favorable climate envelope, or human-induced land use changes designed to mitigate greenhouse gases (e.g., the construction of renewable energy projects such as wind farms or solar arrays may remove key habitats or create barriers).

There are six **species-specific sensitivity** factors considered by the CCVI. These factors are listed below with a brief summary/explanation.

1. *Dispersal and movements* – species with poor dispersal abilities may not be able to track shifting favorable climate envelopes.

2. *Predicted sensitivity to temperature and moisture changes* – species requiring specific moisture and temperature regimes may be less likely to find similar areas as the climate changes and previously-

associated temperature and precipitation patterns uncouple. Four separate factors are scored here as listed below in a through d:

a. Historical and physiological sensitivity to changes in temperature.
b. Historical and physiological sensitivity to changes in precipitation, hydrology, or moisture regime.
c. Dependence on a specific disturbance regime likely to be impacted by climate change – species dependent on habitats that are maintained by regular disturbances (e.g., fires or flooding) are vulnerable to climate change-induced changes in the frequency and intensity of these disturbances.
d. Dependence on ice, ice-edge, or snow-cover habitats – the extent of oceanic ice sheets and mountain snow fields are decreasing as temperatures increase, imperiling species dependent on these habitats.

3. *Restriction to uncommon geological features or derivatives* – species requiring specific substrates, soils, or physical features such as caves, cliffs, or sand dunes may become vulnerable to climate change if their favored climate conditions shift to areas without these physical elements.

4. *Reliance on interspecific interactions* – because species will react idiosyncratically to climate change, those with tight relationships with other species may be threatened. A series of five factors are scored within this category as listed below in a through e:

a. Dependence on other species to generate habitat.
b. Dietary versatility (animals only).
c. Pollinator versatility (plants only).
d. Dependence on other species for propagule dispersal.
e. Forms part of an interspecific interaction not covered above.

5. *Genetic factors* – a species' ability to evolve adaptations to environmental conditions brought about by climate change is largely dependent on its existing genetic variation. Two factors are included in this category:

a. Measured genetic variation.
b. Occurrence of bottlenecks in recent evolutionary history.

6. Phenological response to changing seasonal temperature and precipitation dynamics – research suggests that some phylogenetic groups are declining due to lack of response to changing annual temperature dynamics (e.g., earlier onset of spring, longer growing season), including some bird species that have not advanced their migration times, and some temperate zone plants that are not moving their flowering times.

The final section of the CCVI incorporates any available data on **documented or modeled response** to climate change. This is an optional section and is not required for the CCVI to calculate a vulnerability score. If peer-reviewed, published data are available related to a species response to climate change (e.g., range shifts, range contraction, or phenology mismatches), the species response would be scored in this section. Additionally, the results of available species-specific models can be incorporated in this section.

After all of the appropriate factors are scored, an overall CCVI score is automatically calculated by the tool (i.e., Extremely Vulnerable, Highly Vulnerable, Moderately Vulnerable, Not Vulnerable/Presumed Stable, or Not Vulnerable/Increase Likely), and a measure of confidence of the score (Very High, High, Moderate, Low) is provided. This confidence relates specifically to the level of uncertainty indicated by the assessor based on the range of values given for each factor. Checking a range of values for particular factors tends to decrease confidence in species information.

The CCVI does not include factors that are already considered in existing conservation status assessments. Conservation status ranks assess a species vulnerability to extinction from a wide variety of factors such as population size, range size, threats, and demographic factors. These types of factors are not repeated in the CCVI. The CCVI only takes into consideration those factors that are related to a species vulnerability to climate change. The goal is for the CCVI to complement NatureServe Conservation Status Ranks and not to partially duplicate factors. Ideally, CCVI scores and Conservation Status Ranks should be used in concert.

Complex interactions such as shifts in competitive, predator-prey, or host-parasite interactions are likely to be important as well, but they are not included in this rapid assessment because of the difficulty and unpredictability inherent in simultaneous evaluation of climate change on interacting species.

Applying the CCVI to Nevada's Species of Conservation Priority

Species' range maps and natural history information were obtained from a number of sources including the Nevada Wildlife Action Plan (WAP) (Wildlife Action Plan Team, 2006), the NNHP Biotics database, The Revised Nevada Bat Conservation Plan (Bradley et al., 2006), Atlas of the Breeding Birds of Nevada (Floyd et al., 2007), The Nevada Comprehensive Bird Conservation Plan (GBBO, 2010), NatureServe Explorer, federal agency documents (e.g., USGS professional reports or published studies, USFWS Recovery Plans, Federal Register), field guides, and expert input.

In addition, once available, the results of habitat modeling for certain key habitats conducted by TNC (TNC, 2011), and the results of bird population modeling conducted by GBBO (GBBO, 2011) were incorporated into the CCVI tool to score the appropriate factors for certain species.

Assessments were completed for a representative group of species within each taxonomic group. After these initial CCVI scores were calculated by NNHP, an expert workshop was held (December 2009 in Reno) to solicit feedback and comments from biologists working throughout Nevada. The two-day workshop was well-attended and included representatives from federal (BLM, EPA, NPS, USFS, and USFWS) and state (NDOW, NNHP) agencies, a non-profit organization (TNC), and academia (UNR). Highly constructive comments and feedback were obtained from the attendees on the scoring of the factors, and additional species information was also obtained to better inform the assessments. All feedback and comments were incorporated into the CCVI for each species and scores were recalculated.

In total, 340+ species were assessed using the CCVI, 256 of which are included in this WAP as Nevada SOCP. The results of the CCVI assessments for the SOCP, including CCVI scores and the factors contributing to the species vulnerability (if applicable), were used in the development of the Species Accounts. A detailed table of CCVI results, including the scores for each factor, the overall vulnerability score, and confidence for each SOCP, is included in Appendix D, Table 1.

2012 Species of Conservation Priority Lists

The following is the listing of the Species of Conservation Priority for the Nevada Wildlife Action (WAP) Revision (2012). Some species from the 2005 list remain while new species were added and are distinguished by the *green, italicized font*.

Aquatics

Mollusks

Common Name	Scientific Name
California floater	*Anodonta californiensis*

Gastropods

Common Name	Scientific Name
Amargosa tryonia	*Tryonia variegata*
Antelope Valley pyrg	*Pyrgulopsis pellita*
Ash Meadows pebblesnail	*Pyrgulopsis erythropoma*
bifid duct pyrg	*Pyrgulopsis peculiaris*
Big Warm Spring pyrg	*Pyrgulopsis papillata*
Blue Point pyrg	*Pyrgulopsis coloradensis*
Butterfield pyrg	*Pyrgulopsis lata*
Camp Valley pyrg	*Pyrgulopsis montana*
Corn Creek pyrg	*Pyrgulopsis fausta*
Crystal Spring pyrg	*Pyrgulopsis crystalis*
Distal-gland pyrg	*Pyrgulopsis nanus*
Dixie Valley pyrg	*Pyrgulopsis dixensis*
Duckwater pyrg	*Pyrgulopsis aloba*
Duckwater Warm Springs pyrg	*Pyrgulopsis villacampae*
Elko pyrg	*Pyrgulopsis leporina*
elongate Cain Spring pyrg	*Pyrgulopsis augustae*
elongate Mud Meadows pyrg	*Pyrgulopsis notidicola*
elongate-gland pyrg	*Pyrgulopsis isolata*
Emigrant pyrg	*Pyrgulopsis gracilis*
Fairbanks pyrg	*Pyrgulopsis fairbanksensis*
Flag pyrg	*Pyrgulopsis breviloba*
flat-topped Steptoe pyrg	*Pyrgulopsis planulata*
Fly Ranch pyrg	*Pyrgulopsis bruesi*
grated tryonia	*Tryonia clathrata*
Hardy pyrg	*Pyrgulopsis marcida*
Hubbs pyrg	*Pyrgulopsis hubbsi*
Humboldt pyrg	*Pyrgulopsis humboldtensis*

Common Name	Scientific Name
Kings River pyrg	*Pyrgulopsis imperialis*
Lake Valley pyrg	*Pyrgulopsis sublata*
Landyes pyrg	*Pyrgulopsis landyei*
large gland Carico pyrg	*Pyrgulopsis basiglans*
Lockes pyrg	*Pyrgulopsis lockensis*
longitudinal gland pyrg	*Pyrgulopsis anguina*
median-gland Nevada pyrg	*Pyrgulopsis pisteri*
minute tryonia	*Tryonia ericae*
Moapa pebblesnail	*Pyrgulopsis avernalis*
Moapa Valley pyrg	*Pyrgulopsis carinifera*
monitor tryonia	*Tryonia monitorae*
neritiform Steptoe Ranch pyrg	*Pyrgulopsis neritella*
northern Soldier Meadow pyrg	*Pyrgulopsis militaris*
northern Steptoe pyrg	*Pyrgulopsis serrata*
northwest Bonneville pyrg	*Pyrgulopsis variegata*
Oasis Valley pyrg	*Pyrgulopsis micrococcus*
ovate Cain Spring pyrg	*Pyrgulopsis pictilis*
Pahranagat pebblesnail	*Pyrgulopsis merriami*
Pleasant Valley pyrg	*Pyrgulopsis aurata*
Point of Rocks tryonia	*Tryonia elata*
Pyramid Lake pebblesnail	*Fluminicola dalli*
Sada’s pyrg	*Pyrgulopsis sadai*
small gland Carico pyrg	*Pyrgulopsis bifurcata*
smooth juga	*Juga interioris*
southeast Nevada pyrg	*Pyrgulopsis turbatrix*
southern Duckwater pyrg	*Pyrgulopsis anatina*
southern Soldier Meadow pyrg	*Pyrgulopsis umbilicata*
southern Steptoe pyrg	*Pyrgulopsis sulcata*
sportinggoods tryonia	*Tryonia angulata*
Spring Mountains pyrg	*Pyrgulopsis deaconi*
squat Mud Meadows pyrg	*Pyrgulopsis limaria*
Steptoe hydrobe	*Eremopyrgus eganensis*
sterile basin pyrg	*Pyrgulopsis sterilis*
sub-globose Steptoe Ranch pyrg	*Pyrgulopsis orbiculata*
transverse gland pyrg	*Pyrgulopsis cruciglans*
turban pebblesnail	*Fluminicola turbiniformis*
Twentyone Mile pyrg	*Pyrgulopsis millenaria*
Upper Thousand Spring pyrg	*Pyrgulopsis hovinghi*
Vinyards pyrg	*Pyrgulopsis vinyardi*
Virginia Mountains pebblesnail	*Fluminicola virginius*

Common Name	Scientific Name
White River Valley pyrg	*Pyrgulopsis sathos*
Wong's pyrg	*Pyrgulopsis wongi*

Fishes

Common Name	Scientific Name
Alvord chub	*Gila alvordensis*
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*
Big Smoky Valley speckled dace	*Rhinichthys osculus lariversi*
Big Smoky Valley tui chub	*Gila bicolor ssp.* (unnamed)
Big Spring spinedace	*Lepidomeda mollispinis pratensis*
bonytail chub	*Gila elegans*
bull trout (Jarbidge River basin pop)	*Salvelinus confluentus pop. 4*
Clover Valley speckled dace	*Rhinichthys osculus oligoporus*
Cui-ui	*Chasmistes cujus*
desert dace	*Eremichthys acros*
Devils Hole pupfish	*Cyprinodon diabolis*
Diamond Valley speckled dace	*Rhinichthys osculus ssp.* (unnamed)
Fish Lake Valley tui chub	*Gila bicolor ssp.* (unnamed)
flannelmouth sucker	*Catostomus latipinnis*
Hiko White River springfish	*Crenichthys baileyi grandis*
Independence Valley speckled dace	*Rhinichthys osculus lethoporus*
Independence Valley tui chub	*Gila bicolor isolata*
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*
Little Fish Lake Valley tui chub	*Gila bicolor ssp.* (unnamed)
Meadow Valley speckled dace	*Rhinichthys osculus ssp.* (unnamed)
Meadow Valley Wash desert sucker	*Catostomus clarkii ssp.* (unnamed)
Moapa dace	*Moapa coriacea*
Moapa speckled dace	*Rhinichthys osculus moapae*
Moapa White River springfish	*Crenichthys baileyi moapae*
Monitor Valley speckled dace	*Rhinichthys osculus ssp.* (unnamed)
Moorman White River springfish	*Crenichthys baileyi thermophilus*
mountain whitefish	*Prosopium williamsoni*
Oasis Valley speckled dace	*Rhinichthys osculus ssp.* (unnamed)
Pahranagat roundtail chub	*Gila robusta jordani*
Pahranagat speckled dace	*Rhinichthys osculus velifer*
Pahrump poolfish	*Empetrichthys latos latos*
Preston White River springfish	*Crenichthys baileyi albivallis*
Railroad Valley springfish	*Crenichthys nevadae*
Railroad Valley tui chub	*Gila bicolor ssp.* (unnamed)

Common Name	Scientific Name
razorback sucker	*Xyrauchen texanus*
relict dace	*Relictus solitarius*
Sheldon tui chub	*Gila bicolor eurysoma*
tui chub of Dixie Valley	*Gila bicolor ssp. 9*
Virgin River chub	*Gila seminuda*
Virgin River chub (Muddy River pop.)	*Gila seminuda pop. 2*
Virgin River spinedace	*Lepidomeda mollispinis mollispinis*
Wall Canyon sucker	*Catostomus sp.*
Warm Springs Amargosa pupfish	*Cyprinodon nevadensis pectoralis*
Warner Valley redband trout	*Oncorhynchus mykiss pop. 4*
White River desert sucker	*Catostomus clarkii intermedius*
White River speckled dace	*Rhinichthys osculus ssp. 7*
White River spinedace	*Lepidomeda albivallis*
White River springfish	*Crenichthys baileyi baileyi*
woundfin	*Plagopterus argentissimus*
Yellowstone cutthroat trout	*Oncorhynchus clarkii bouvieri*

Amphibians

Common Name	Scientific Name
Amargosa toad	*Anaxyrus nelsoni*
Arizona toad	*Anaxyrus microscaphus*
Columbia spotted frog (Great Basin pop)	*Rana luteiventris pop. 3*
Great Basin spadefoot	*Spea intermontana*
Great Plains toad	*Anaxyrus cognatus*
northern leopard frog	*Lithobates pipiens*
relict leopard frog	*Lithobates onca*
Sierra Nevada yellow-legged frog*	Rana sierra*
western toad	*Anaxyrus boreas*

Terrestrial

Reptiles

Common Name	Scientific Name
chuckwalla	*Sauromalus ater*
desert night lizard	*Xantusia vigilis*
desert horned lizard	*Phrynosoma platyrhinos*
desert iguana	*Dipsosaurus dorsalis*
desert tortoise (Mojave Desert pop.)	*Gopherus agassizii*
Gila monster	*Heloderma suspectum*
long-nosed leopard lizard	*Gambelia wislizenii*

Common Name	Scientific Name
Great Basin collared lizard	*Crotaphytus bicinctores*
greater short-horned lizard	*Phrynosoma hernandesi*
northwestern pond turtle	*Actinemys marmorata marmorata*
northern rubber boa	*Charina bottae*
pygmy short-horned lizard	*Phrynosoma douglasii*
Panamint alligator lizard	*Elgaria panamintina*
ring-necked snake	*Diadophis punctatus*
rosy boa	*Lichanura trivirgata*
Shasta alligator lizard	*Elgaria coerulea shastensis*
sidewinder	*Crotalus cerastes*
Sierra alligator lizard	*Elgaria coerulea palmeri*
Smith's black-headed snake	*Tantilla hobartsmithi*
Sonoran mountain kingsnake	*Lampropeltis pyromelana*
spotted leaf-nosed snake	*Phyllorhynchus decurtatus*
western banded gecko	*Coleonyx variegatus*
western brush lizard	*Urosaurus graciosus*
western red-tailed skink	*Plestiodon gilberti rubricaudatus*
Mojave shovel-nosed snake	*Chionactis occipitalis*
western threadsnake	*Rena humilis*

Birds

Common Name	Scientific Name
American Avocet	*Recurvirostra americana*
American Bittern	*Botaurus lentiginosus*
American White Pelican	*Pelecanus erythrorhynchos*
Bell's Vireo	*Vireo bellii*
Bald Eagle (Contiguous US Pop)	*Haliaeetus leucocephalus*
Bank Swallow	*Riparia riparia*
Bendire's Thrasher	*Toxostoma bendirei*
Black Rosy-Finch	*Leucosticte atrata*
Black Tern	*Chlidonias niger*
Black-chinned Sparrow	*Spizella atrogularis*
Bobolink	*Dolichonyx oryzivorus*
Brewer's Sparrow	*Spizella breweri*
California Spotted Owl	*Strix occidentalis occidentalis*
Canvasback	*Aythya valisineria*
Cassin's Finch	*Carpodacus cassinii*
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*
Common Loon	*Gavia immer*

Common Name	Scientific Name
Common Nighthawk	*Chordeiles minor*
Dusky Grouse	*Dendragapus obscurus*
Ferruginous Hawk	*Buteo regalis*
Flammulated Owl	*Otus flammeolus*
Gilded Flicker	*Colaptes chrysoides*
Golden Eagle	*Aquila chrysaetos*
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*
Great Basin Willow Flycatcher	*Empidonax traillii adastus*
Greater Sage-Grouse	*Centrocercus urophasianus*
Greater Sandhill Crane	*Grus canadensis tabida*
Le Conte's Thrasher	*Toxostoma lecontei*
Lewis's Woodpecker	*Melanerpes lewis*
Loggerhead Shrike	*Lanius ludovicianus*
Long-billed Curlew	*Numenius americanus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Mountain Quail	*Oreortyx pictus*
Northern Goshawk	*Accipiter gentilis*
Northern Pintail	*Anas acuta*
Olive-sided Flycatcher	*Contopus cooperi*
Peregrine Falcon	*Falco peregrinus*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Prairie Falcon	*Falco mexicanus*
Redhead	*Aythya americana*
Red-necked Phalarope	*Phalaropus lobatus*
Rufous Hummingbird	*Selasphorus rufus*
Sage Sparrow	*Amphispiza belli*
Sage Thrasher	*Oreoscoptes montanus*
Scott's Oriole	*Icterus parisorum*
Short-eared Owl	*Asio flammeus*
Sierra Nevada Mountain Willow Flycatcher	*Empidonax traillii brewsteri*
Sooty Grouse	*Dendragapus fuliginosus*
Southwestern Willow Flycatcher	*Empidonax traillii extimus*
Tricolored Blackbird	*Agelaius tricolor*
Virginia's Warbler	*Vermivora virginiae*
Western Burrowing Owl	*Athene cunicularia hypugaea*
Western Least Bittern	*Ixobrychus exilis hesperis*
Western Sandpiper	*Calidris mauri*
Western Snowy Plover	*Charadrius alexandrinus nivosus*
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*
White-faced Ibis	*Plegadis chihi*

Common Name	Scientific Name
White-headed Woodpecker	*Picoides albolarvatus*
Wilson's Phalarope	*Phalaropus tricolor*
Yuma Clapper Rail	*Rallus longirostris yumanensis*

Mammals

Common Name	Scientific Name
Allen's big-eared bat	*Idionycteris phyllotis*
American marten	*Martes americana*
American pika	*Ochotona princeps*
American water shrew	Sorex palustris
bighorn sheep	*Ovis canadensis*
Botta's pocket gopher	*Thomomys bottae*
California leaf-nosed bat	*Macrotus californicus*
cave myotis	*Myotis velifer*
dark kangaroo mouse	*Microdipodops megacephalus*
desert kangaroo rat	*Dipodomys deserti*
desert pocket mouse	*Chaetodipus penicillatus*
fringed myotis	*Myotis thysanodes*
hoary bat	*Lasiurus cinereus*
Humboldt yellow-pine chipmunk	*Neotamias amoenus celeris*
Inyo shrew	*Sorex tenellus*
little brown myotis	*Myotis lucifugus*
long-eared myotis	*Myotis evotis*
Merriam's shrew	*Sorex merriami*
Mexican free-tailed bat	*Tadarida brasiliensis*
Mono Basin mountain beaver	*Aplodontia rufa californica*
montane shrew	*Sorex monticolus*
mountain pocket gopher	*Thomomys monticola*
mule deer	*Odocoileus hemionus*
northern flying squirrel	*Glaucomys sabrinus*
northern river otter	Lontra canadensis
Pahranagat Valley montane vole	*Microtus montanus fucosus*
pale kangaroo mouse	*Microdipodops pallidus*
Palmer's chipmunk	*Neotamias palmeri*
Preble's shrew	*Sorex preblei*
pygmy rabbit	*Brachylagus idahoensis*
sagebrush vole	*Lemmiscus curtatus*
shadow (Allen's) chipmunk	*Neotamias senex*
Sierra Nevada snowshoe hare	*Lepus americanus tahoensis*
silver-haired bat	*Lasionycteris noctivagans*

Common Name	Scientific Name
spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Corynorhinus townsendii*
western jumping mouse	*Zapus princeps*
western red bat	*Lasiurus blossevillii*
western small-footed myotis	*Myotis ciliolabrum*
Wyoming ground squirrel	*Spermophilus elegans nevadensis*

**Species common and/or scientific name have changed since 2005 plan.*

Rationale for Adding New Species of Conservation Priority

The following aquatic and terrestrial species were added to the SOCP list based on climate change analysis through the CCVI or other demonstrated conservation concern for the species. For additional information, please refer to the Species Accounts section of this plan.

Aquatic Species

Blue point pyrg

The Blue Point springsnail was added as an SOCP due to its unknown status, highly localized habitat, and susceptibility to threats such as water issues and exotic species invasion.

Alvord chub

Occupies low-elevation, moderate gradient montane stream habitats subject to projected higher level climate change effects from increased thermal load and altered seasonal runoff patterns including reduced, late warm season, base flows.

Little Fish Lake Valley tui chub

Occupies sub-montane (valley floor) isolated spring/pool and wetland habitats which are subject to accelerated effects from climate change, including increased thermal loads. These habitat types are dependent on non-carbonate aquifers and local recharge which are also subject to the effects from changes in seasonal precipitation and early spring onset of runoff events.

Meadow Valley speckled dace

Occupies mid to low-elevation montane streams. May be impacted by groundwater development and projected climate change effects, such as increased thermal inputs and greater frequency in stochastic flow events (e.g. changed monsoonal storm patterns) affecting habitat quality and distribution.

Meadow Valley Wash desert sucker

Occupies mid to low-elevation montane streams, may be impacted from groundwater development and projected climate change effects from increased thermal inputs and greater frequency in stochastic flow events (e.g. changed monsoonal storm patterns) affecting habitat quality and distribution.

Mountain whitefish

Occupies mid- to high-elevation montane stream and river habitats conspecific with native trout species. Projected effects from climate change are similar to Lahontan Cutthroat Trout (LCT) and other native cutthroat trout and include impacts from increased thermal loads, reductions in total habitat suitability and linear extent and negative habitat changes from modified runoff patterns and reduced late summer base flows.

Relict dace

Occupies isolated spring, springbrook, and wetland habitats. Specific impacts are projected on some populations from proposed groundwater development projects. Thermal effects from climate change are anticipated to restrict total available habitat and distribution for populations; populations that occur in non-carbonate aquatic systems which are subject to a higher degree of climate change related flow effects.

Sheldon tui chub

Occupies low-elevation (valley floor) spring/pool and stream habitats that are subject to projected higher level climate change effects, such as increased thermal load and altered seasonal runoff patterns, including reduces late warm season base flows.

Warner Valley redband trout

Occupies mid-elevation montane stream systems with projected impacts from climate change including increased thermal loading and shifts in temporal stream flow patterns affecting habitat suitability and habitat distribution

Yellowstone cutthroat trout

Occupies mid- to high-elevation montane stream systems with projected impacts from climate change through increased thermal loading and shifts in temporal stream flow patterns affecting habitat suitability and habitat distribution

Great Basin spadefoot

New species because of disease concerns and potential effects from climate change on amphibians in general due to life history requirements. Could be threatened by large scale habitat conversion.

Western toad

Although this species is common throughout the Great Basin, there are potentially isolated and endemic species that need more certain taxonomic delineation.

Terrestrial Species

American Bittern

This was added to the SOCP because of perceived population declines in the U.S. and western region. This species is moderately vulnerable to climate change and its preferred habitat is sensitive and vulnerable to degradation.

Bank Swallow

This was added to the SOCP list due to continental population declines and continued concern in California. This species is moderately vulnerable to climate change.

Common Nighthawk

This was added to the SOCP list due to significant declining trends in the U.S., western region, and the Great Basin.

Flammulated Owl

This was added as a new WAP species due to rangewide population declines and concerns over conifer habitat with respect to climate change.

Gilded Flicker

This was added to the SOCP list due to its restricted range in Nevada and declining trend rangewide.

Golden Eagle

This was added to the SOCP list due to its inclusion in the Bald & Golden Eagle Protection Act. There are also concerns with conflicts with renewable energy development.

Prairie Falcon

This was added to the SOCP list due to potential conflicts with renewable energy development.

Sage Thrasher

This was added to the SOCP list because it is moderately vulnerable to climate change and due to the possibility of large scale sagebrush habitat conversion and loss.

Scott's Oriole

This was added to the SOCP list due to declining population trends in Nevada and because its preferred Joshua tree habitat is vulnerable to climate change.

Western Sandpiper

This was added as an SOCP in the WAP due to its declining rangewide population trend and Nevada's stewardship responsibility for this species during migration.

Wilson's Phalarope

This species was added to the SOCP list because it is moderately vulnerable to climate change. Its preferred breeding habitat is sensitive and vulnerable to degradation. Nevada also has migration stewardship responsibility.

Northern rubber boa

This species was added to the SOCP list because it requires mesic microhabitats in the Great Basin that are vulnerable to drying due to climate change and reliant upon aspen riparian areas, a vulnerable habitat type.

Ring-necked snake

This species was added to the SOCP list because it requires mesic microhabitats in the Mojave Desert that are vulnerable to drying due to climate change.

Rosy boa

This was added as a new WAP species because it occurs in isolated populations that leave the species vulnerable to decline especially with respect to climate change and collection. In addition, it is only found in one location within Nevada.

Sidewinder

This species was added to the SOCP list because of current and increasing habitat development and fragmentation, especially in consideration of alternative energy development and large scale solar power plants.

Smith's blackhead snake

This species was added to the SOCP list because it has fragmented populations and its habitat is vulnerable to deterioration especially with respect to climate change.

Spotted leaf-nosed snake

This species was added to the SOCP list because of current and increasing habitat fragmentation, especially in consideration of alternative energy development and large scale solar power plants.

Western threadsnake

This was added as a new WAP species because it requires mesic microhabitats in the Mojave Desert that are vulnerable to drying due to climate change.

Mojave shovel-nosed snake

This species was added to the SOCP list because of current and increasing habitat fragmentation, especially in consideration of alternative energy development and large scale solar power plants.

Mexican free-tailed bat

This was added as an SOCP in the WAP because of this species' habit of roosting in large colonies and its vulnerability to decline due to energy development.

Sierra Nevada snowshoe hare

This species was added to the SOCP list because it is an isolated subpopulation with limited habitat connectivity and shared stewardship with California.

Silver-haired bat

This species was added to the SOCP list because of regional population concerns and is especially vulnerable to wind turbine collision/mortality.

DEFINING NEVADA'S LANDSCAPE FOR WILDLIFE

For the Nevada Wildlife Action Plan (WAP), an ecological framework for strategy development was devised for initial analyses using ecoregions and modified Bailey's sections. Modified Bailey's sections are divisions within an ecoregion that are defined by similarities of geomorphic process, surface geology, soils, drainage networks, and regional climate patterns. Four ecoregions and 10 modified Bailey's sections overlap Nevada (Figure 4) (CPET 1999; MDEPT 2001; Nachlinger et al., 2001).

Although there are several different ecoregional classifications in use in the United States, there is a great deal of overlap in all of the maps and scrutiny reveals more similarities than differences (Groves, 2003). Ecoregional boundaries should not be taken too literally because there is typically a gradual transition from one major ecosystem type to another and only rarely are ecoregional boundaries represented by distinct edges. In addition, most ecoregions contain patches of habitats that are more representative of adjacent ecoregions. We also recognize that ecological classification is not a panacea for categorizing all taxa or biological features. As the Nevada WAP evolved, the complexity and often redundant nature of attempting to create a strategic plan using modified Bailey's sections as our units of planning became evident. Specifically, key habitat types for wildlife occur across multiple sections and ecoregions. The complexity of forcing aquatic species and their habitats into a mostly terrestrial-based system was also problematic.

Aquatic species and their habitats are more easily categorized into a system defined by hydrologic factors. The aquatic framework is more appropriately defined by ecological drainage units which are aggregations of fourth level hydrologic unit codes (HUCs). Ecological drainage units can be subdivided into fifth and sixth level HUCs (subbasin or watershed scale) which refines the aquatic framework to a more focused, smaller scale and is particularly important for the discussion and planning for many of the isolated aquatic species found throughout Nevada. Currently, HUCs defined at the eighth level are easily available for Nevada. However, since most Nevada Aquatic Species of Conservation Priority are geographically isolated populations, it became evident that developing a finer-level system would be a very useful tool for identifying and managing key populations.

For hydrologic analysis and water planning and management purposes, the U.S. Geological Survey (USGS) and the Nevada Division of Water Resources (NDWR), Department of Conservation and Natural Resources, have divided the state of Nevada into 256 Hydrographic Areas and Sub-Areas. This smaller hydrologic unit typically comprises a valley, a portion of a valley, or terminal basin. It would be beneficial to aquatic species conservation for NDOW to partner with NDWR, USGS, the Nevada Department of Environmental Protection, universities, conservation groups, and other aquatic resource planning bodies to develop and incorporate a standardized hydrologic unit system at this scale that would aid in exchange of information.

While the four major ecoregions in Nevada are readily recognizable to most partners, Bailey sections were not an intuitive framework for the development of aquatic species conservation strategies. For aquatic species, much of the structure for conservation delivery is already in place in the form of county or multi-county species conservation working groups. . In this context, partner feedback indicated that framing objectives and actions by key habitat type would offer an effective approach.

As a result, the Nevada WAP provides a user-friendly format to the multiple partners that will be involved in its implementation. A framework based on modified Bailey's sections will likely be useful in the terrestrial ecological linkage for future partnership development with California, Oregon, Idaho, Utah, and Arizona. The use of HUCs that by their nature overlap state boundaries will be useful in linking aquatic conservation efforts among neighboring states. Multi-state implementation of WAPs will facilitate the identification of common priorities. Collaboration among western states will also promote cooperative studies for wildlife and their key habitats that will address objectives across ecologically based units rather than geopolitical boundaries.

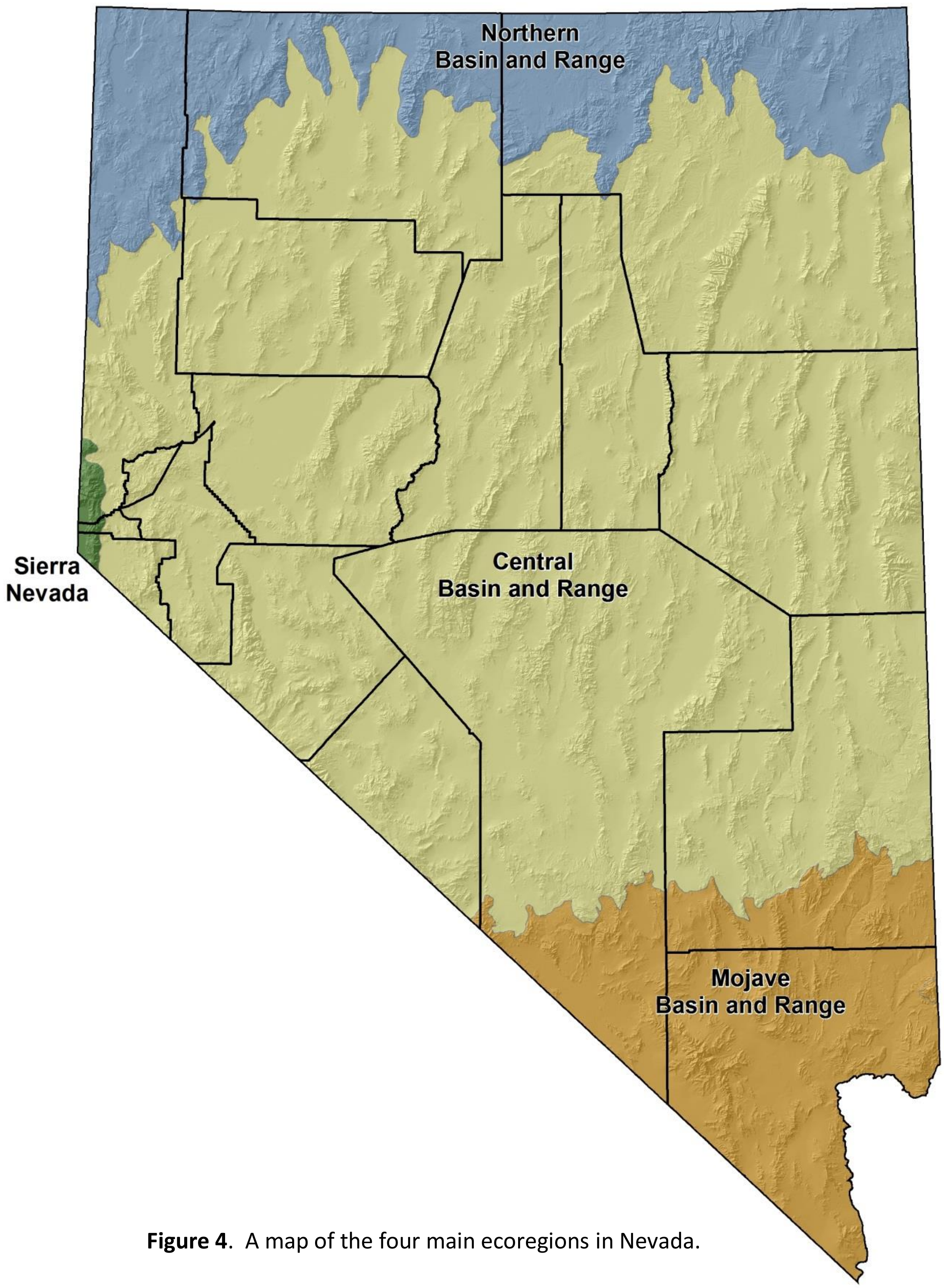


Figure 4. A map of the four main ecoregions in Nevada.

Key Habitats

Aquatic Habitat Information

Because of the absence of an easily definable aquatic habitat geospatial data layer which fit into the developed structure of this process, the WAP team chose a hybrid approach to incorporating aquatic habitat information. Rather than develop an entirely separate, HUC based, aquatic habitat definition structure, which would have been duplicative of much of the information contained in associated terrestrial habitat definitions, aquatic habitats have been incorporated into their associated terrestrial key habitat groups. This applies primarily to flowing water (stream or lotic) habitats, and also to smaller standing water (lentic) aquatic habitats such as montane pools and marshes. Where the ability exists to more clearly define aquatic features on the landscape, these have been presented as the unique key habitat groups, Lakes and Reservoirs and Spring and Springbrook aquatic habitats. This structure has the benefit of closely linking aquatic and terrestrial habitat strategies for those key habitats, such as stream systems, where conservation and management approaches must integrate aquatic and terrestrial components to ensure these systems are fully functional and supporting diverse species assemblages at their full potential.

Linking Nevada's Species of Conservation Priority to 22 Key Habitats

After identifying the Species of Conservation Priority and describing the habitat framework for which the conservation strategies will be developed, the next step was to link the priority species to the habitat framework so that the strategies will be relevant to species conservation. The assumption in effecting the species-habitat linkage is that species occur in habitats based on the availability of key structural elements that satisfy a species' most basic needs for food, cover, and reproductive needs (nesting, denning, etc.). Enough is known about the basic life history needs of most vertebrate species in Nevada that they can be roughly characterized and categorized by the key habitat elements to which they respond. For example, birds that feed on insects in the canopies of cottonwood trees are characterized as "overstory/canopy" species; while many reptiles respond positively to the rocky landscape features in their habitats ("rocks/canyons"). Species that respond to the same set of habitat features were grouped together in species assemblages – literally, species assembled together by similar habitat needs.

Conservation strategies for habitat management were written toward the needs of these species assemblages by addressing the conservation issues associated with the maintenance of the key habitat features. For example, one of the 22 Key Habitats is Intermountain Conifer Forests and Woodlands. Goals and objectives for this habitat address natural processes to maintain the structure but they also incorporate the value of this habitat to Nevada's WAP Species of Conservation Priority. Structural attributes of intermountain conifer forests and woodlands important to wildlife such as a mature overstory or the presence of snags and cavities were identified and species were grouped within these features ("species assemblages"). For aquatic species, cold versus hot springs or ephemeral versus permanent water sources are important distinctions for setting conservation objectives. However, for many key habitat types incorporating aquatic species, assemblages of those species are driven as much by the isolation and local endemism of those species as they are by specific structural characteristics of individual aquatic habitats within the key type. Species assemblages are identified for each of the 22 Key Habitats and were formulated through a series of workshops and interviews with species experts in Nevada, supplemented by information available in the literature describing species requirements.

In addition to habitat-based strategies addressing the needs of species assemblages, actions for individual species are identified. This was necessary when the required action is not habitat-based, or when it involves species-based research or monitoring. Even though the species in question might have broad habitat use patterns, an attempt was made to attach the species-based action to the Key Habitat strategy where it was most likely to have relevance. This was purely an organizational decision that was made to avoid the need to write a separate section for species-based action.

Many of the species-based conservation actions call for the development of species/habitat relationships models. These studies and the resultant models basically describe the species-habitat linkage through key habitat features that are used to inform conservation strategy development in this plan. The refinement of knowledge of these relationships will allow better understanding of the habitat features influencing species' distribution on the landscape, create better-informed species assemblages, and develop a more critically-focused conservation strategy with better prospects for success.

See Figure 5 and Table 2 for additional information on the ecological system groups and associated key habitats.

The WAP Conservation Landscape and Focal Areas

The second required element for Nevada's WAP includes describing the locations of key areas essential to the conservation of fish and wildlife species of concern. Addressing this element began with a landscape analysis that identified areas in Nevada that represented the highest biodiversity of WAP Species of Conservation Priority.

Focal areas were identified as discrete landscape units using the natural basin and range geography of the Nevada landscape. These units were prioritized using biodiversity and species richness measures based upon NDOW and NNHP observations and element occurrences for species of conservation priority. Focal areas were initially determined be those basin and range units that captured as least one documented occurrence of at least 90% of the species of conservation priority. Basin and range units were then added manually such that at least one occurrence of the remaining 10% of the species of conservation priority (e.g. localized, endemic populations) were represented. Landscape units were also added to include Audubon Important Bird Areas (2012), NNHP Scorecard sites (2006), significant spring landscapes (NNHP, 2011), greater sage-grouse preliminary priority habitat (NDOW, 2012), crucial mule deer habitat (NDOW, 2009), and crucial bighorn sheep habitat (NDOW, 2010) that were not already represented by the basin and range units with high biodiversity (see Appendix G).

The resulting focal areas map (Figure 1 in Appendix G) provides information about the location of biologically diverse areas in Nevada, highlights landscapes containing endemic species, and recognizes important areas identified in prior conservation planning efforts. The map does not provide a prioritization of individual landscapes but is intended as an informational resource for strategy development and implementation. Each key habitat strategy in the Nevada WAP includes a list of associated focal areas based upon the landscape assessment described above. Focal areas provide a general overview of key areas for fish and wildlife but by no means are intended to imply that conservation action should be restricted to these areas. Prioritization of key areas in the conservation landscape will be carried out by local working groups during WAP implementation. The focal areas provide a framework for evaluating Nevada's WAP in a statewide context to help determine the extent to which conservation actions identified in the 22 key habitat strategies are benefiting the WAP Species of Conservation Priority.

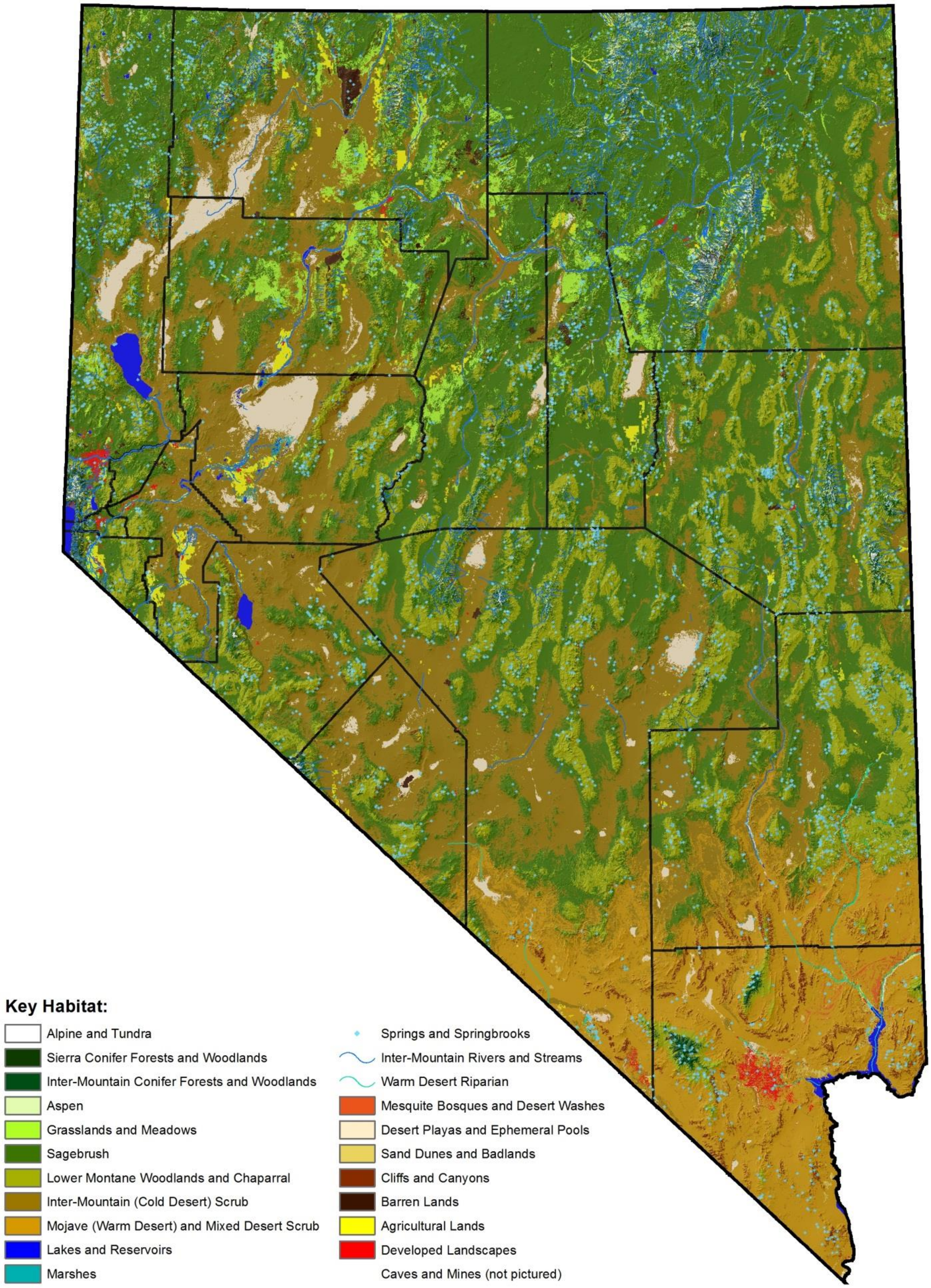


Figure 5. Ecological Systems Groups incorporated into the Nevada WAP.

Table 2. Nevada's Ecological Systems, Key Habitats, and Ecological System Groups

Ecological System Group	Key Habitat	Ecological System
Basins and Desert Scrub	Intermountain (cold desert) scrub	Intermountain Basins Greasewood Flat
		Intermountain Basins Mixed Salt Desert Scrub
		Intermountain Basins Semi-desert Shrub Steppe
		Intermountain Basins Wash
	Mojave mid-elevation mixed desert scrub	Colorado Plateau Blackbrush-Mormon tea Shrubland
		Mojave Mid-elevation Mixed Desert Scrub
	Mojave/Sonoran (warm desert) scrub	Sonora-Mojave Creosote bush-White Bursage Desert Scrub
		Sonora-Mojave Mixed Salt Desert Scrub
		Sonora-Mojave-Baja Semi-Desert Chaparral
Developed Lands and Agriculture	Agricultural lands	Agriculture
	Developed landscapes	Developed, Medium - High Density
		Developed, Open Space - Low Intensity
Lower Montane	Lower montane chaparral	Great Basin Semi-Desert Chaparral
		Mogollon Chaparral
	Lower montane woodlands	Great Basin Piñon-Juniper Woodland
		Intermountain Basins Juniper Savanna
		Intermountain Basins Mountain Mahogany Woodland and Shrubland
		Rocky Mountain Gambel Oak-Mixed Montane Shrubland
Riparian and Wetlands	Desert playas & ephemeral pools	Intermountain Basins Playa
		North American Warm Desert Playa
	Intermountain rivers and streams	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
		Rocky Mountain Subalpine-Montane Riparian Shrubland
		Rocky Mountain Subalpine-Montane Riparian Woodland
	Lakes and Reservoirs	Open Water
	Marshes	North American Aid West Emergent Marsh
	Mesquite bosques and desert washes	North American Warm Desert Riparian Mesquite Bosque
		North American Warm Desert Wash
	Mojave rivers and streams	Invasive Southwest Riparian Woodland and Shrubland
		North American Warm Desert Lower Montane Riparian Woodland and Shrubland
		North American Warm Desert Riparian Woodland and Shrubland
	Wet Meadows	Mediterranean California Subalpine-Montane Fen
		Rocky Mountain Alpine-Montane Wet Meadow

Ecological System Group	Key Habitat	Ecological System
		Temperate Pacific Montane Wet Meadow
Sagebrush Semidesert	Sagebrush	Great Basin Xeric Mixed Sagebrush Shrubland
		Intermountain Basins Big Sagebrush Shrubland
		Intermountain BasinsBig Sagebrush Steppe
		Intermountain Basins Montane Sagebrush Steppe
Sand Dunes and Badlands	Cliffs and Canyon	Colorado Plateau Mixed Bedrock Canyon and Tableland
		Intermountain Basins Cliff and Canyon
		North American Warm Desert Bedrock Cliff and Outcrop
		North American Warm Desert Volcanic Rockland
		Sierra Nevada Cliff and Canyon
	Sand dunes and badlands	Intermountain Basins Active and Stabilized Dune
		North American Warm Desert Active and Stabilized Dune
		North American Warm Desert Badland
		North American Warm Desert Pavement
Montane to Alpine	Alpine and tundra	Mediterranean California Alpine Bedrock and Scree
		Rocky Mountain Alpine Bedrock and Scree
		Rocky Mountain Dry Tundra
	Aspen woodland	Intermountain West Aspen-Mixed Conifer Forest and Woodland Complex
		Rocky Mountain Aspen Forest and Woodland
	Grasslands and meadows	Intermountain Basins Semi-Desert Grassland
		North Pacific Montane Grassland
		Rocky Mountain Subalpine Mesic Meadow
		Southern Rocky Mountain Montane-Subalpine Grassland
	Intermountain conifer forests and woodlands	Intermountain Basins Subalpine Limber-Bristlecone Pine Woodland
		Rocky Mountain Bigtooth Maple Ravine Woodland
		Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland
		Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
		Rocky Mountain Ponderosa Pine Woodland
		Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
		Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
	Sierra conifer forests and	Mediterranean California Dry-Mesic Mixed Conifer

Ecological System Group	Key Habitat	Ecological System
	woodlands	Forest and Woodland
		Mediterranean California Ponderosa-Jeffrey Pine Forest and Woodland
		Mediterranean California Red Fir Forest and Woodland
		Northern Pacific Mesic Subalpine Woodland
		Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland
Other	Barren landscapes	Barren Lands, non-specific
		Recently Burned
		Recently Mined or Quarried
	Invasive grasslands and forblands	Invasive Annual and Biennial Forbland
		Invasive Annual Grassland
		Invasive Perennial Grassland

CONSERVATION STRATEGIES FOR NEVADA'S 22 KEY HABITATS AND THEIR ASSOCIATED WILDLIFE

The Nevada Wildlife Action Plan approach to wildlife conservation is based on 22 individual key habitat conservation strategies. Each of the 22 key habitat conservation strategies provides the key habitat's particular importance to wildlife and each key habitat's associated Species of Conservation Priority organized by the important features of the habitat type that most influence the presence of the species ("key habitat elements important to wildlife"). Included in this section are the predicted effects of climate change and wildlife responses to those effects, each key habitat's current condition, current land uses, and current problems in meeting its full contribution to statewide comprehensive wildlife conservation. A Conservation Strategy has been designed for each key habitat, consisting of goals written in terms of desired landscape conditions, directional objectives (increase, decrease, maintain) that are measurable with respect to their overall trend by the end of the planning period, and suggested management actions that could significantly contribute toward the movement of the objectives into the desired direction. While most management actions are habitat-based, some management actions are non-habitat-based and refer to a single species or sometimes groups of species. While species-based actions could occur across a variety of habitat types, we attempted to present actions in the habitat type that is key to their implementation to avoid redundancy in the text. In addition, each strategy identifies focal areas for conservation action that are based on existing plans and expert consultation.

Once the threats to wildlife conservation posed by climate change and other agents of change were identified, strategies to reverse or mitigate the effects of all the threats including climate change were solicited from technical expert groups, taken from the 2005 Plan, other conservation plans, or the literature wherever possible. The strategies, activities, treatments, prescriptions, programs, and initiatives were often unchanged from the 2005 Plan for the species persisting on the priority list from 2005. A feature of the TNC habitat analysis was the gathering of regional ecological restoration focus groups to construct restoration, remedial, and preventive prescriptions for action specific to their own regions based on their own expertise and experience.

After the basic prescriptive approaches were identified, the Revision Team strove to set quantified, measurable objectives to set the progress marks for the applications of those prescriptions. Where ecological departure of an ecological system (biophysical setting) was of major concern and had been quantified for the 50-year period of analysis, objectives aimed at reversing, stabilizing, or minimizing the rate of ecological departure of the ecological system were developed for the immediate 10-year period following approval of the Revision (2012-2022). A general finding of the climate change projections was that the period between 40 and 50 years from now would witness the greatest increment of change toward the 50-year projected outcome, and often the first 10-year period (that relevant to this revision) would witness the least. Setting up the monitoring framework to measure climate change effects was much more the need during this first 10-year period, and sometimes in terms of actually observing physical change on the landscape.

As with terrestrial species, strategies, activities, treatments, prescriptions, programs, and initiatives were largely unchanged from those developed for the 2005 Plan for aquatic species carried forward from the 2005 priority list, and new species added from the current analysis generally could be grouped with a species or set of species previously prioritized. The level of degradation of aquatic habitats supporting priority aquatic species in Nevada remains substantial because of both physical alteration and the presence of undesirable non-native species, and specific substantive threats to these habitats identified in the 2005 plan such as future groundwater development and invasive species remain largely unabated. To the extent that potential climate change effects identified in the analysis such as increased thermal input from air temperature rise and altered streamflow regimes resultant from temporal changes in precipitation and modified runoff patterns will modify aquatic habitat quality for priority aquatic species, these will be modifiers that to some extent will just amplify the impacts of existing threats. For this reason in many cases predicted climate change inputs did not substantially alter existing proposed actions, prescriptions and conservation targets, but place increased emphasis on the importance of those targets and prescriptions because their effective implementation generally will increase the resiliency of aquatic systems in the face of projected climate related effects.

The Nevada WAP Team addressed climate change within the terrestrial key habitats under the following headings: "Predicted Climate Change Effects," "Possible Wildlife Responses to Climate Change," and "Taking Prescriptive Action." However, the aquatic key habitats (e.g., Warm Desert Riparian, Springs and Springbrooks, Marshes) only address "Predicted Climate Change Effects," and "Possible Wildlife Responses to Climate Change". Because the available TNC climate change analysis focused primarily on "ecological departure" of vegetative systems and associated changes to native terrestrial habitats, it provided limited utility for assessing changes to aquatic systems and associated effects on resident native aquatic species, particularly fishes. For a number of reasons it was not possible to develop more sophisticated modeling tools for identifying aquatic system effects at a detailed level, and a relatively coarse-filter approach was used to evaluate predicted climate change effects. Therefore, the heading and discussion in the "Taking Prescriptive Action" under terrestrial key habitats was not feasible for development in the aquatic key habitats.

Recognizing the current limitations on developing adequate and comprehensive analysis of predicted climate change effects on many of Nevada's aquatic systems and associated aquatic species, primarily due to the absence of necessary data sets and climate change models or analysis applicable to aquatic systems at a useful scale and resolution, we will continue to work with key conservation partners to identify suitable tools that will allow more detailed and comprehensive analysis of those potential aquatic system effects. As those tools are identified further analysis will be performed to refine our understanding of predicted climate change effects on key aquatic habitats and associated fishes and other native aquatic species of concern, informing the development of management strategies for those habitats and species and active implementation of appropriate prescriptive actions.

Intermountain Cold Desert Shrub

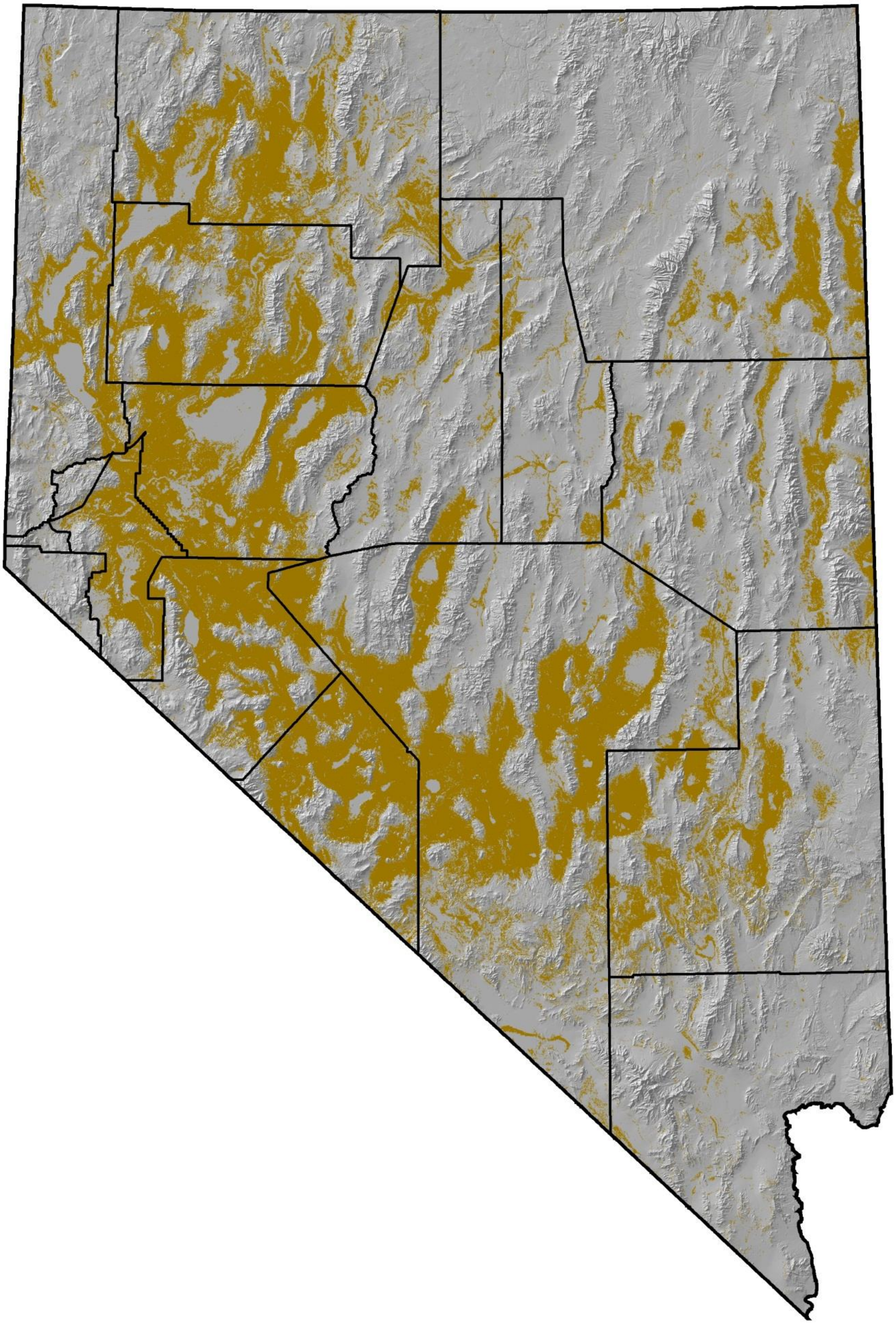


Figure 6. Distribution of Intermountan Cold Desert Shrub in Nevada.

KEY HABITAT: INTERMOUNTAIN COLD DESERT SHRUB

Things to Know….

- Intermountain Cold Desert Shrub habitat is the most extensive habitat type in Nevada.
- Key priority species include Loggerhead Shrike and pale kangaroo mouse.
- Habitat threats include non-native invasive plants and recreation (OHV).
- Climate change will accelerate invasion by cheatgrass and changes in fire return interval and recovery potential.
- Restoration techniques are expensive, success rates are very low, and ecological values associated with these communities are not the highest priority; therefore, restoration prescriptions were not developed.

Ecoregions

Southwest ReGAP 2005

Great Basin	6,899,940 hectares	17,036,888 acres
Mojave	427,106 hectares	1,054,583 acres
Columbia Plateau	182,205 hectares	449,889 acres
Sierra Nevada	558 hectares	1,379 acres
Total	7,509,809 hectares	18,542,739 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Mixed Salt Desert…………………	SO65 Intermountain Basins Mixed Salt Desert Scrub
	SO70 Sonora-Mojave Mixed Salt Desert Scrub
	SO79 Intermountain Basins Semi-Desert Scrub Steppe
Greasewood…………………………..	SO96 Intermountain Basins Greasewood Flat

Key Habitat Description

The Intermountain Cold Desert Shrub type is the most extensive habitat type in the state of Nevada, covering roughly 6.1 million hectares. Annual precipitation in the salt desert shrub zone is generally less than 10 inches per year. Temperatures range between extremes of -20F and 110F, with mean temperatures somewhere in the low 50s Fahrenheit. Distribution of the salt desert shrub type generally follows all the valley bottoms in the state that occur within the Great Basin physiographic region. Plant communities are generally characterized by the presence of a variety of salt-tolerant shrubs of the Goosefoot family (Chenopodiaceae).

Community composition is largely influenced by soil salinity and drainage. Most often, the salt desert shrub type is dominated by either shadscale or greasewood. At the lowest flats of the valleys where soils drain poorest and salinities are highest, the most salt-tolerant plants are found, including pickleweed and quailbush. The salt desert shrub type generally gives way to sagebrush somewhere near the tops of the alluvial fans where the primary fault lines of the mountain range are situated. These upper soils are often gravelly and well-drained, and are more likely to support spiny hopsage, bud sagebrush, and associated plants. The dominant grass species in the salt desert shrub type is Indian ricegrass, and to a lesser extent, needle-and-thread grass.

Value to Wildlife

Intermountain Cold Desert Shrub is the most important habitat in Nevada for several Species of Conservation Priority, including pale kangaroo mouse and Loggerhead Shrike. Soils of this habitat tend to be loose and either sandy or gravelly and are often easy to dig. Blow sand tends to accumulate around the shrubby bases of the saltbushes, particularly shadscale. This creates hummocks of soil that lend themselves to burrowing and denning. The two most dependable herbivorous food staples are ricegrass and shadscale seeds, although forb seeds and leaf material will also be used when present. In the Great Basin, Intermountain Cold Desert Shrub is also the primary habitat of the long-nosed leopard lizard, and is an important feeding habitat for pallid bats, which pluck scorpions and other large invertebrates off its exposed desert flats. Loggerhead Shrikes attain high breeding densities in valley bottoms such as Lahontan Valley, where quailbush and four-wing saltbush create huge mature plants as much as 10 feet in diameter. These big shrubs serve as thorny redoubts protecting the shrike's nest found deep inside the most unreachable depths of the foliage. Bald Eagles winter in the valley bottoms, preying on jack rabbits, while Prairie Falcons feed primarily on rodents in the ground squirrel-cottontail size class. Intermountain Cold Desert Shrub serves as an important support habitat for several sagebrush breeders, including Sage Thrasher, Sage Sparrow, and Brewer's Sparrow. Washes are prominent features within the Intermountain Cold Desert Shrub habitat type, and have unique attributes for certain terrestrial species, including endemic amphibians because of their function as a conduit for surface runoff and subsoil moisture. By retaining higher soil moisture than surrounding upland areas, they can serve as enhanced movement and migration pathways for these species and facilitate their distribution across the landscape, perhaps serving an important role in amphibian metapopulation maintenance.

Key Elements of Intermountain Cold Desert Shrub Habitat Important to Wildlife

SHRUBS – nesting structure, protection from predators, thermal cover

- Loggerhead Shrike
- Sage Sparrow
- Brewer's Sparrow
- Sage Thrasher

SANDY SOILS – burrowing, denning

- Burrowing Owl
- pale kangaroo mouse
- dark kangaroo mouse
- long-nosed leopard lizard

ROCK FEATURES/GRAVELLY SOILS – denning, protection from predators

- Great Basin collared lizard
- dark kangaroo mouse

PREY POPULATIONS – feeding on species in this habitat

- Bald Eagle

Ferruginous Hawk
greater short-horned lizard
desert horned lizard

Existing Environment

Habitat Conditions

Historically, Indian ricegrass was likely much more prevalent in this habitat type than it is today. Invasion of exotic plants, including cheatgrass, halogeton, Russian thistle, and in certain places, tamarisk, has compromised native communities and effected a shift toward less desirable conditions. In fact, the TNC report states that significant departure from reference condition has already occurred in the Calcareous and Black Rock Plateau regions. Fire generally does not carry well in this type and is assumed to not have evolved with fire. Shadscale range, once burned, can be extremely difficult and costly to restore to native type. The occurrence of cheatgrass in this type increases its ability to burn more readily. More Intermountain Cold Desert Shrub is burning annually than it likely did historically and therefore it is at much greater risk.

The TNC Report indicated that the Mixed Salt Desert habitat is already significantly departed from its reference conditions throughout much of its northerly and easterly range, with percentages in uncharacteristic classes currently ranging from 35 (Calcareous) to 72% (Black Rock Plateau), with the exception of the Owyhee Plateau (four percent). Habitat integrity is better in the southern regions (Walker, Toiyabe, Tonopah, Mojave), with uncharacteristic class percentages currently ranging from one to 12%.

Land Uses

- Livestock grazing
- Motorized recreation
- Military mission
- Utility rights-of-way
- Species harvest
- Urban/suburban development
- Industrial development
- Road Development

Problems Facing the Species and Habitats

Various land uses have resulted in the reduction or removal of important native seed-bearing grasses and forbs, and in many places native understory has been replaced by non-native invasive species, including cheatgrass, halogeton, Russian thistle, and tamarisk on wetter soils. Off-road vehicle activity can result in serious structural damage to shrubs, stripping them of their value as wildlife cover, and soil disturbance can lead to accelerated erosion, particularly around washes. Localized areas can be vulnerable to overharvest of reptiles for commercial trade, particularly areas with pronounced rock features that harbor highly desirable species such as the Great Basin collared lizard.

Predicted Climate Change Effects

Mixed Salt Desert

As mentioned previously, uncharacteristic classes in the heavily departed northern and eastern regions are expected to increase anywhere from eight to 20% without climate change; with climate change, the increases are similar, but tended to be less severe by two to 12%. In the southern regions, uncharacteristic classes are expected to increase anywhere from 10 to 30% with or without climate change.

Between the two prevalent uncharacteristic classes, annual grass with no shrub component (U-annual grass) is expected to be more unfriendly to wildlife than the shrub-annual grass-perennial grass (U-SAP) category, which maintains at least some shrub cover but is compromised by the invasion of annual grasses. Regions predicted to increase over 10% in the U-annual grass category included all regions except Owyhee, Elko, Walker, and Tonopah. Regions with over 30% of their mixed salt desert habitat predicted to be in the U-annual grass category after 50 years of climate change include Black Rock Plateau (47) and Humboldt (41).

Greasewood

Greasewood habitat is similarly already significantly departed from reference conditions throughout much of its northerly and easterly ranges. Percentages in uncharacteristic classes are over 25% in the Black Rock Plateau, Calcareous, Clover, Elko, Eureka, and Humboldt regions. Uncharacteristic classes in these regions are expected to increase 11-22% in 50 years with climate change. Southern regions are in better condition, currently ranging only from one to seven percent in U-classes, but are predicted to increase 20-35% in U-classes in 50 years with climate change.

Like mixed salt desert, the U-annual grass category is expected to be more unfriendly to wildlife because of the reduced shrub component. Eight regions are predicted to increase over 10% in the U-annual grass category with 50 years of climate change, and three regions (Black Rock, Elko, Eureka) are predicted to have over 30% of its greasewood in the U-annual grass category by then.

Possible Wildlife Responses to Climate Change

Vertebrate species likely to abandon the Salt Desert Shrub habitat with the loss of the shrub layer include Loggerhead Shrike and Sage Thrasher (nesting substrate), pale kangaroo mouse and dark kangaroo mouse (protective and thermal cover; food source), and long-nosed leopard lizard (protective and thermal cover). These species could experience small retractions in distribution across much of the northern range of the Salt Desert Shrub habitat, with particular justification for monitoring in the Black Rock Plateau, Elko, and Humboldt regions.

The GBBO Report indicated that invasions of annual grasses in Intermountain Cold Desert Shrub types accounted for one percent of a projected 14% statewide population decline in Brewer's Sparrow; one percent of a 20% decline in Sage Sparrow; and 1.7% of a 21% decline in Sage Thrasher. A decline in number equal to 3.5% of the current population estimate of Loggerhead Shrike was predicted for cold desert shrub types, but the statewide population decline was predicted to be only one percent, so it is assumed that birds displaced from cold desert shrub would find receptive habitat in other BpS's (biophysical settings).

Taking Prescriptive Action

The restoration ecologists consulted during our prescriptive action workshops did not find mixed salt desert or greasewood to be of high priority for restoration. Restoration techniques are expensive, success rates are very low, and ecological values associated with these communities are not of a high priority; therefore, restoration prescriptions were not developed.

Priority Research Needs

- Wildlife/habitats relationships for all Species of Conservation Priority.
- Document with predictive capability the response of conservation priority species to invasion of annual grasses and cumulative loss of shrub cover in Mixed Salt Desert communities.
- Dark kangaroo mouse habitat preferences and population demography
- Pale kangaroo mouse habitat preferences and population demography
- Predictive model for Burrowing Owl breeding distribution; key breeding habitat delineation
- Post-fire range rehabilitation techniques
- Population resiliency to harvest pressure for Great Basin collared lizard, long-nosed leopard lizard, and desert horned lizard

Conservation Strategy

Goal: Thriving self-sustaining wildlife populations in healthy plant communities on stable soils within the natural range of soil movement (devoid of destructive erosion resulting in diminished site potential); with vigorous shrub component consisting of the full range of species within range site potential capable of reaching mature phenological stages; vigorous, diverse self-sustaining understory of grasses and forbs.

Objective: Prevent the increase in annual grass (no shrub) classes in both mixed salt desert and greasewood from exceeding 15% in all regions through 2022.

Action: Maintain a vigorous overstory shrub component (greasewood, spiny hopsage, four-wing saltbush, quailbush, etc.); maintain capability of five-foot or greater height/diameter for saltbush species such as four-wing saltbush or quailbush conducive to Loggerhead Shrike nesting.

Action: Maintain vigorous, self-sustaining understory of grasses and forbs with particular emphasis on allowing seed-set and dispersal to sustain seed-eating wildlife.

Action: Maintain general range site health so that erosional forces such as water and wind are kept within natural limits, to the extent that this habitat type can maintain those limits.

Action: Retard the spread of invasive weeds and grasses into unaffected areas; maintain the type’s natural fire resistance through maintenance of uncompromised native plant communities.

Action: Maintain rock features, including tufa stacks, rock outcrops, boulder piles, lava flows, cinder scatters, rock float, talus, etc.; monitor local centers of rock removal for industrial or landscaping uses.

Objective: Maintain healthy populations of birds of conservation priority at stable or increasing trend through 2022.

"birds of conservation priority" include Loggerhead Shrike, Sage Thrasher, Sage Sparrow, Brewer's Sparrow, Western Burrowing Owl, Ferruginous Hawk, Bald Eagle

"stable or increasing trend" – as measured by Nevada Bird Count, USGS Breeding Bird Survey, raptor nest monitoring (Ferruginous Hawk), or winter raptor surveys (Bald Eagle).

Action: Continue partner-based funding for the Nevada Bird Count.

Action: Continue to pursue volunteer staffing of all USGS Breeding Bird Survey routes in Nevada.

Action: Develop predictive models and inventory occupied habitat for Western Burrowing Owl for the purpose of developing quantifiable conservation objectives.

Action: Develop a nest occupancy survey for Ferruginous Hawk.

Action: Develop rigorous statistical analyses for statewide winter raptor survey data. Monitor wintering Bald Eagles at the statewide wintering population scale.

Action: Monitor and mitigate local impacts of OHV recreation (organized or private) on burrowing owl nesting areas.

Objective: Maintain dark and pale kangaroo mouse populations at detectable levels through 2022.

"detectable levels" – as measured by routine live trapping annually or at scheduled intervals not to exceed five years)

Action: Implement a regularly scheduled surveillance monitoring project to measure detectability (occupancy) rates for dark and pale kangaroo mouse.

Action: Direct research toward understanding the elements of functionality in dark and pale kangaroo mouse habitat. Characterize the responses of kangaroo mice to invasion of annual grasses and cumulative loss of shrub cover in mixed salt desert habitats.

Objective: Maintain Great Basin collared lizard, long-nosed leopard lizard, desert horned lizard and greater short-horned lizard at detectable levels through 2022.

"detectable levels" – as measured by ocular reptile survey conducted annually or at scheduled intervals not to exceed five years.

Action: Monitor local impacts of commercial reptile collection on key favored collection areas. Regulate take according to monitored and demonstrated need.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	83
Private	13
All others	4

Existing partnerships, plans, and programs

Federal & State Agencies
- Bureau of Land Management
- U.S. Fish & Wildlife Service
  - Sheldon NWR CCP
- Nevada Department of Wildlife

Conservation Organizations
- The Nature Conservancy
- The Sierra Club

Bird Initiatives
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight & Nevada Bird Conservation Plan
- Nevada Audubon Society Important Bird Area Program

Other Key Partners
- Counties
- Great Basin Bird Observatory
- Sportsmen's groups

Focal Areas

Amargosa Desert
Big Smoky Valley
Black Rock Desert
Black Rock Desert West
Black Rock Range
Carson Sink
Fish Lake Valley
Hamilin Valley
Hot Creek Valley
Little Smokey Valley
Pahranagat Valley
Pahrump Valley
Pancake Range
Pyramid Lake Valley
Railroad Valley
Ruby Valley
Silver Peak Range
Snake Valley
Spring Valley
Steptoe Valley
Wassuk Range
White River Valley

Mojave Warm Desert & Mixed Desert Scrub

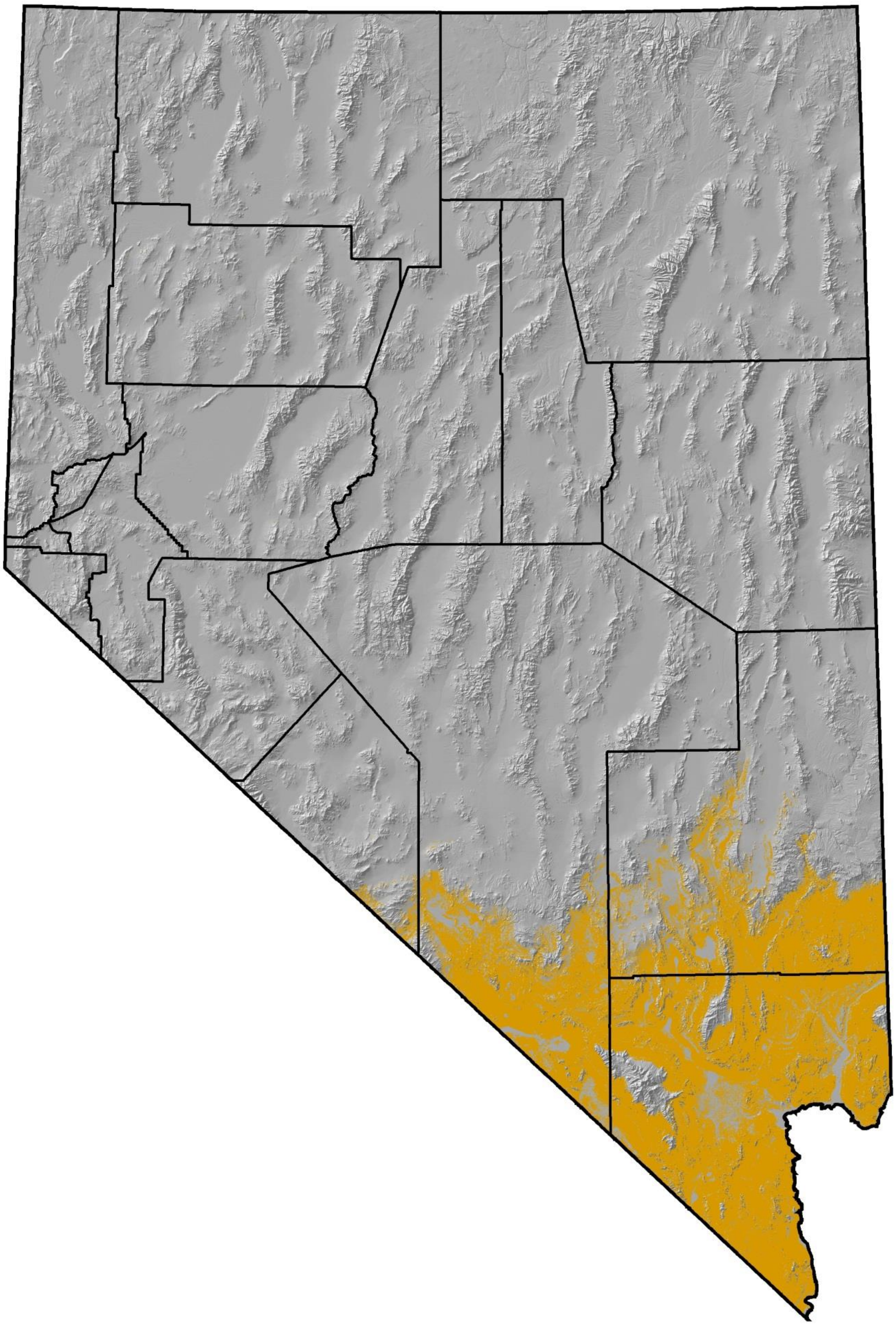


Figure 7. Distribution of Warm Desert & Mixed Desert Scrub in Nevada.

KEY HABITAT: MOJAVE WARM DESERT AND MIXED DESERT SCRUB

Things to Know….

- This key habitat includes the typical creosote bush plant community of the alluvial fans, the Joshua tree forest and tall and short blackbrush communities which are typically found between the desert scrub and the woodland zones on mountain ranges within or near the Mojave Ecoregion.
- Many birds, small mammals, and reptiles depend on Mojave Desert Scrub vegetation for shade and sustenance. Key priority species include desert tortoise in creosote bush and Black-chinned Sparrow in blackbrush.
- Biggest anthropogenic threat is the conversion to developed landscapes.
- Creosote-bursage communities will expand northward and thermic and mesic blackbrush will be 50% shrubless in 200 years due to climate change effects.
- Prescriptive actions include chemical suppression of annual grasses and other invasive plants. New cultivars of native plant species are being developed to increase restoration success rate.

Ecoregions

Southwest ReGAP 2005

Mojave	2,745,950 hectares	6,780,122 acres
Great Basin	748,077 hectares	1,847,104 acres
Total	3,494,027 hectares	8,627,227 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Thermic Blackbrush……………….	SO59 Colorado Plateau Blackbrush-Mormon Tea Shrubland
Mesic Blackbrush…………………..	SO60 Mojave Mid-Elevation Mixed Desert Scrub
Creosote bush -White Bursage..	SO69 Sonora-Mojave-Baja Creosote-White Bursage Desert Scrub

Key Habitat Description

The complex of vegetation types that comprise the Mojave Warm Desert and Mixed Desert Scrub habitat are uniquely adapted to the harsh conditions present in desert ecosystems. Plants are typically tolerant of low humidity, prolonged droughts, desiccating winds, rocky or very sandy soils, and the periodic influx of high quantities of water in the form of surface flooding. Extensive alluvial fans, or bajadas, reach from the perimeter of the mountains down to the low intervening basins. These alluvial fans are where the Mojave Warm Desert Scrub plant communities are found. This key habitat also includes the Joshua tree forest and two transitional brush communities that are typically found between the desert scrub and the woodland zones on mountain ranges within or near the Mojave Ecoregion.

Creosote scrub (Sonora-Mojave-Baja Creosote-White Bursage Desert Scrub) occurs on well-drained sandy flats and bajadas throughout most of the Mojave Desert from 150 to 1500 meters elevation in Nevada. Its range extends from the Colorado River on the south to Pahranagat Valley on the north. Dominant plant species are creosote bush, white bursage, Mormon tea, and beavertail cactus. Joshua tree can be scattered to abundant.

Thermic blackbrush (Colorado Plateau Blackbrush-Mormon Tea Shrubland) generally occurs from approximately 850 to 1575 m (2750-5150 ft) elevation on flat or low-gradient settings less than 15 degrees, occasionally on moderate to steep slopes (30-40 degrees). Soils are predominantly rapidly-drained, sandy loams that rarely contain silt and clay. The underlying geology is usually limestone, shale, or less frequently sandstone. Trees are essentially absent, although Joshua tree can be common. A short-shrub layer dominated by blackbrush (*Coleogyne ramosissima)* associated with three species of white bursage, Mormon Tea, banana yucca, prickly pear, and century plant. Grasses include low woolygrass*,* slim tridens, and sixweeks fescue, and the exotic red brome and stork's bill (*Erodium cicutarium)* invade this site. A variety of forbs, including globemallow and several Compositae species, occur sparsely in the understory.

The mesic blackbrush BpS more or less conforms to the Southwest ReGAP ecological system Mojave Mid-Elevation Mixed Desert Scrub. It is typically found above the 23-25cm (9-10 inch) precipitation zone. Dominant or co-dominant shrubs include Joshua tree, blackbrush, Mormon tea, hopsage, staghorn cholla, Gambel's oak, greenleaf manzanita, and cup-leaf ceanothus. Juniper, and more rarely pinyon, can be common to dominant, especially at higher elevations. Grass understory species associated with these brush communities include Indian ricegrass, needle-and-thread, and James' galleta. In this biophysical setting, blackbrush attains a much larger growth form, often growing to heights over six feet tall, creating a very different wildlife habitat than the short, scrubby thermic version.

Value to Wildlife

Creosote Bush-White Bursage and Thermic Blackbrush

The harsh conditions and abundant xerophytic vegetation types associated with the creosote bush-white bursage and thermic blackbush BpS's would, at first glance, give the impression of a somewhat inhospitable and uninviting habitat. However, a large compliment of wildlife species, including many bird, small mammal, and reptile species depend on or at least partially utilize these BpS's as well as adjacent habitats. Here is found the desert tortoise, listed as threatened under the federal Endangered Species Act. Desert tortoises often place their burrows directly under creosote bushes, taking advantage of the substrate stability created by the creosote roots. A host of additional heat-tolerant reptile species are also dependent on this habitat, including the desert iguana, Gila monster, and spotted leaf-nosed snake. The rocky slopes of many of southern Nevada's mountain ranges are critical to the survival of desert bighorn sheep. Desert kangaroo rats and the desert pocket mouse depend on windblown sandy areas within the creosote bush-white bursage and thermic blackbrush BpS, and creosote seeds make up a large part of the desert pocket mouse's diet. In turn, these small mammals and reptiles are an important prey source for snakes, burrowing owl, and loggerhead shrike. While it does not in and of itself define a vegetative association, the presence of Joshua tree in Nevada is critical to the presence of Bendire's Thrasher and desert night lizard.

Mesic Blackbrush

Mesic blackbrush habitats provide much more vegetative structure and cover for wildlife, particularly birds, than either creosote bush or thermic blackbrush. The Black-chinned Sparrow has a very limited distribution in Nevada, found in the largely impenetrable shrubby stands of blackbrush and chaparral, often along the pinyon-juniper interface. Joshua tree is a very important dwarf tree found in all three communities. Similar to creosote bush-white bursage and thermic blackbrush, the presence of Joshua tree in mesic blackbrush is critical to the presence of Bendire's Thrasher and desert night lizard.

Key Elements of Mojave Warm Desert and Mixed Desert Shrub Habitat Important to Wildlife

DWARF SHRUB –nesting structure, protection from predators, thermal cover
western banded gecko
desert iguana
desert horned lizard
spotted leaf-nosed snake
Mojave shovel-nosed snake

ROCKS/CANYONS-nesting structure, protection from predators, thermal cover
Great Basin collared lizard
Chuckwalla
Gila monster
rosy boa
California leaf-nosed bat
desert bighorn sheep

WASH ECOTONE-foraging
western brush lizard
western threadsnake
Western red-tailed skink
ring-necked snake

SANDY SOILS – burrowing, denning
long-nosed leopard lizard
desert tortoise
desert pocket mouse
sidewinder
desert kangaroo rat
Burrowing Owl

YUCCA – nesting structure, protection from predators
desert night lizard
Bendire's Thrasher
Gilded Flicker

MESIC BLACKBRUSH-nesting structure, protection from predators
Black-chinned Sparrow

Existing Environment

Land Uses

- Urban/suburban development
- OHV recreation
- Military mission

- Renewable energy development
- Sand/gravel mining
- Wild horse/burro range
- Species harvest

Historic and Current Conditions

Creosote Bush-White Bursage

Throughout southern Nevada, development is occurring at a rate which could ultimately directly impact approximately 20% of the total acreage of this habitat type, and indirectly impact a much more sizable portion. Much of the habitat outside of the Las Vegas Valley is in relatively good condition, although these areas are subject to increasing pressure from factors such as invasive species, wildfire, and dispersed recreational activity. Approximately 80% of the total amount of this habitat type in Nevada occurs within Clark County, where an estimated 70% is under some form of protection for the purpose of conserving critical habitat for the desert tortoise, mostly on large blocks of public lands designated as Areas of Critical Environmental Concern. Up to the year 2005, about 20% of the habitat within Clark County could be considered as improving in condition over the past 10 years due to the cessation of grazing and off-highway vehicle use resulting from desert tortoise management initiatives. Since 2005, however, large blocks of protected habitat invaded by red brome and non-native mustard burned as part of the Southern Nevada Fire Complex; as a result, large parts of the Eastern Mojave Desert have become non-native annual grasslands and forblands (stork's bill). Wild horses and burros continue to be problematic; in some areas their numbers are declining due to the inability of the range to support them.

Thermic and Mesic Blackbrush

Prior to the wet year of 2005, thermic and mesic blackbrush were considered mostly intact, owing largely to desert tortoise conservation and the inclusion of much of the montane shrub types within the Spring Mountains NRA. During 2005; however, heavy precipitation allowed non-native red brome and mustard to dominate the understory of shrublands throughout the Mojave Desert. This dominance persists to this day with cover variation governed entirely by cumulative precipitation. The heavy fuels burned that in 2005, as part of the 508,751-acre Southern Nevada Fire complex, caused a shift to non-native annual grasslands and forblands. The species blackbrush was largely eliminated from burned areas and there is no expectation of blackbrush to return as the species requires centuries to thousands of year for site recolonization of surfaces devoid of plant competition (i.e., no non-native species).

Problems Facing the Species and Habitats

The biggest challenge facing wildlife in the Mojave Warm Desert and Mixed Desert Scrub is conversion of habitat through urban and suburban development, including the scheduled installation of solar energy panel fields on thousands of acres of public land, and uncharacteristic wildfire. Off-highway vehicle recreation attendant to suburban growth is heavily impacting the urban-wildland interface, leaving structural damage to shrubs and soils that lead to accelerated erosion. Wild horse and burro populations are over-capacity in many areas, and the range is depleted of its diverse understory of seed-bearing grasses and forbs. Invasive species threatening to replace the native understory in many places include red brome, cheatgrass, halogeton and Russian thistle. Overharvest of reptiles may be occurring in certain areas harboring highly-desirable species (e.g., chuckwalla, Great Basin collared lizard).

Predicted Climate Change Effects

Ground-truthing the LANDFIRE classification data in all three BpS's featured in this chapter – creosote bush-white bursage, thermic blackbrush, and mesic blackbrush - revealed that 91% of these types were already invaded by annual grasses even though the shrub component was mostly intact. Without significant advances in the technology of range restoration, the shrub-annual grass-perennial forb expression for these types cannot transition back to characteristic classes and can only be expected to slowly transition from shrub-annual-perennial to a shrubless annual grass expression as the fire interval continues to be accelerated by the presence of the annual grasses. Mesic blackbrush is known, in some regions, to sprout from rootstock after fire, if the fire is not too severe. The rate of transition from annual-invaded shrub to largely shrubless annual grassland, directly resultant from fire activity, is hard to predict but it does not appear the transition will be complete in 50 years, or that significant shrub stands will be reduced to the point of seriously impacting wildlife distribution over that period.

Creosote Bush-White Bursage

The TNC modeling predicted the appearance of creosote bush-white bursage in regions adjacent to the Mojave that do not currently have this habitat type. This would suggest the northerly expansion of creosote bush-white bursage from its current range with rising temperatures – a standard prediction of climate change ecological effect. The ranges of potential expansion in acres predicted by the five modeling runs per each are presented in Appendix C for the affected regions.

Thermic and Mesic Blackbrush

Based on the TNC modeling, the current blackbrush landscape in the Mojave might be expected to be 50% shrubless in 200 years (Appendix C).

Possible Wildlife Responses to Climate Change

The importance of shrub overstory in the Mojave shrublands cannot be overstated. Most critically, shrubs provide indispensible thermal cover (shade) for not only poikilothermic (cold-blooded) reptiles, but for homeothermic (warm-blooded) mammals and birds also. In addition to temperature microclimates, shrubs also provide humidity microclimates important for small terrestrial wildlife. Fallen debris from shrubs provides cover and helps retain some water in the soil. An already challenging environment would only increase in hostility under the combined effects of increasing temperature and loss of shrub cover. In addition, shrubs provide escape cover from predators and in the case of herbivores, Mojave shrubs and cacti provide food in the form of foliage, seeds, fruit, and pulp (cactus) which could not be compensated for by annual grass production alone. Current knowledge is sorely lacking regarding Mojave vertebrate population responses to reductions in shrub cover. It is assumed that thresholds would be reached beyond which species would no longer be able to survive on the landscape, and it is plausible those thresholds differ between species.

Another important element of the Mojave landscape, particularly for lizards, is the quantity and species of insects it supports. Insects, and with some species particularly ants, are critical in the diet of several lizards and smaller snakes. Information is sorely lacking regarding insect species responses to a transition from a shrubland to a non-native annual grassland and forbland in the Mojave. For instance, research is required to know if species such as desert horned lizards are dependent on certain ant species over others, if desirable ant species are going to persist with habitat transitioning or be replaced by others, and if the replacement species will be satisfactory to support horned lizards. The importance of other orders of insects, arachnids, etc. in the maintenance of wildlife populations in the Mojave must also be more precisely assessed and understood.

The scenario of a shrubless Mojave landscape formerly populated by creosote bush-white bursage in 20 years (200 to 500 years for blackbrush) would force its vertebrate inhabitants to move to adjacent habitats – most notably pinyon-juniper, coniferous forest, and warm desert riparian – and try to survive there. The persistence of a species would be influenced by its ability to survive in alternate habitats, given its unique life history requirements and ability to compete with species already adapted to thrive in the alternate habitats. These inter- and intraspecific shifts are impossible to predict, but must be monitored and understood as we progress into a warmer, ecologically-compromised landscape.

The GBBO bird response analysis predicted a 22% decline in Black-chinned Sparrow populations associated with the predicted loss of mesic blackbrush. While some habitat types would pick up the “displaced” birds, a statewide population decline of 19% over all habitat types was predicted for Black-chinned Sparrow. The GBBO report predicted an 11% reduction in the statewide population of Scott’s Oriole largely associated with the loss of early blackbrush classes and late mesic blackbrush. It must be noted that biologists believe the presence of Scott’s Oriole to be strongly influenced by the occurrence of Joshua tree; therefore, this predicted loss would be predicated on the assumption that Joshua trees would be lost with the blackbrush type designation. A ten percent reduction in statewide population of LeConte’s Thrasher was largely influenced by loss of the early creosote bush-white bursage BpS. It should be noted that LeConte’s Thrasher’s preferred habitat is generally regarded as the salt desert scrub communities occurring on valley bottoms in the Mojave Desert. It is possible this plant community is somewhat embedded in the early creosote bush/white bursage type.

Taking Prescriptive Action

Thermic and Mesic Blackbrush

The Mojave restoration working group proposed restoration strategies for both blackbrush types. Three treatments that shared the use of an herbicide suppressing the germination of annual species were prescribed. See Appendix C for more prescriptive action information.

Creosote Bush-White Bursage

The challenge described for restoration of blackbrush is equally true for creosote bush-white bursage. Restoration solutions are also similar, although the BpS is more productive because it occupies deeper and loamier soils than blackbrush. See Appendix C for more prescriptive action information.

Priority Research Needs

- Species-habitat relationships/predictive models that demonstrate vertebrate and invertebrate species responses to the loss of shrubs in Mojave types.
- Distribution, population demography, ecology of Gila monster
- Habitat integrity/connectivity analysis for Mojave shovel-nosed snake, spotted leaf-nosed snake, and sidewinder.
- Wildlife responses to conversion of Mojave shrubscapes to solar energy fields

Conservation Strategy

Goal: Healthy, self-sustaining wildlife populations in healthy plant communities on stable soils with vigorous shrub component consisting of the full range of species within range site potential; vigorous, diverse self-sustaining understory of grasses and forbs.

Objective: No net unmitigated loss or fragmentation of habitat in areas designated by the Clark County Multiple Species Habitat Conservation Plan as "Intensive Management Areas" or "Less Intensive Management Areas," or in areas designated as "Multiple Use Management Areas" that represent the majority of habitat for a species through 2022.

Action: Integrate Wildlife Action Plan objectives with objectives and conservation actions outlined in the Clark County MSHCP.

Action: Integrate Wildlife Action Plan objectives and actions into BLM Resource Management Plans through plan revision process.

Action: Maintain wild horse and burro herds within Allotment Management Levels (AML).

Action: Monitor OHV activity on wild lands. Incorporate Wildlife Action Plan objectives into OHV management plans. Develop conservation education program for responsible use of OHVs in and near sensitive wildlife habitat; include regularly updated information on closed areas. Augment law enforcement activity in closed areas.

Action: Update Clark County MSHCP covered species information with latest Wildlife Action Plan species information. Integrate Wildlife Action Plan Species of Conservation Priority with Covered Species list of the Clark County MSHCP.

Objective: Prevent the transition of undeveloped Mojave Shrub habitats to uncharacteristic classes from exceeding 30% in mesic blackbrush and creosote bush-white bursage and 10% in thermic blackbrush through 2022.

("transition to uncharacteristic classes" – as measured via remote sensing tools such as LANDFIRE or its developmental analogs.)

Action: Support the development of biological control agents infecting red brome.

Action: Develop a range restoration program that implements herbicides and other management tools to control the spread of invasive annual grasses and re-seeding of native plants after fire.

Action: Develop hardy cultivars of native plants that perform with better success rates from seed or seedling stage to produce the results of restoration strategies described above.

Action: Maintain functional connectivity between existing intact Mojave Shrub habitats and northward extensions of Mojave Shrub into new regions, particularly for small mammals and reptiles with particular focus on the cumulative impacts of habitat conversion associated with the development of solar energy generation fields.

Objective: Maintain populations of birds of conservation priority at stable trend and distribution concomitant with climate change habitat shifts through 2022.

("stable trend" – as measured by Nevada Bird Count, USGS Breeding Bird Survey, or supplemental special species monitoring protocol)

Action: Establish targeted point count transects to supplement the Nevada Bird Count's ability to detect and monitor Bendire's Thrasher and Black-chinned Sparrow.

Action: Conduct comprehensive species investigations, including distribution, population demography, and ecology for Bendire's Thrasher and Black-chinned Sparrow. Develop conservation plans for each species based on results of comprehensive studies.

Action: Coordinate with partners on a Western Burrowing Owl inventory and monitoring protocol.

Action: Monitor and mitigate local impacts of OHV recreation on burrowing owl nesting areas.

Action: Monitor the status and trend of Gilded Flicker in Nevada as well as its dependence on paloverde-mixed cactus habitat predicted to expand into Nevada with climate change, or alternatively, its capability to adapt away from paloverde-cactus habitats traditionally used in Arizona.

Objective: ***(adapted from the Desert Tortoise Recovery Plan 2011 Revision)*** **Maintain self-sustaining, well-*distributed populations of desert tortoises within each recovery unit through 2022.***
"self-sustaining" - Rates of population change (λ) for desert tortoises are increasing (i.e., λ > 1) over at least 25 years (a single tortoise generation), as measured
a) by extensive, range-wide monitoring across tortoise conservation areas within each recovery unit, and
b) by direct monitoring and estimation of vital rates (recruitment, survival) from demographic study areas within each recovery unit.
"well-distributed" - Distribution of desert tortoises throughout each tortoise conservation area is increasing over at least 25 years (i.e., ψ [occupancy] > 0).

Action: Implement the recommendations of the Mojave Desert Tortoise Recovery Plan.

Action: Develop a survey project that monitors local impacts of commercial reptile collection on key favored collection areas.

Objective: Maintain Western red-tailed skink, western brush lizards and desert night lizards at detectable levels in suitable habitat through 2022.

"detectable levels" – as determined by regularly scheduled surveillance monitoring (ocular or pit trap survey) conducted at intervals not to exceed five years. While these species probably could be tracked by a statistically-viable trend monitoring project, commercial collection interest in them has remained low and the priority for developing a trend model for them would be low over the next 10 years barring unforeseen circumstances.

Action: Develop and field test habitat suitability models for Western red-tailed skink, western brush lizard, and desert night lizard. Develop a model for densities, distribution, and general habitat preferences for each species.

Action: Assess conservation risk for western brush lizard and desert night lizard based on habitat trend, measurement of ecological departure of preferred habitats, and anticipated (and/or measured) impacts on the species based on their life history needs and habitat use.

Action: Monitor specific effects of climate change on Western red-tailed skink habitats. Perform habitat connectivity analysis and population viability analysis if deemed necessary.

Objective: Maintain healthy viable populations of spotted leaf-nosed snake, Mojave shovel-nosed snake, western threadsnake, ring-necked snake, and sidewinder at detectable levels through 2022.

"detectable levels" – as determined by regularly scheduled surveillance monitoring (night drive or pit trap survey) conducted at intervals not to exceed five years.

Action: Determine solar development impacts on Mojave shovel-nosed snakes and sidewinders distribution, habitat connectivity, and movement corridor maintenance.

Action: Develop a night drive/pit trap survey network regionally targeted to gather detections and information on these snake species.

Action: Develop a habitat connectivity monitoring program and develop goals, objectives, and contingency strategies for maintaining habitat and population connectivity at regional and local scales.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	83
Private	13
Other	4

Existing partnerships, plans, and programs

Multi-partner

- Clark County Multiple Species Habitat Conservation Plan
- Mojave Desert Tortoise Recovery Plan
- Bureau of Land Management Las Vegas Resource Management Plan
- Desert National Wildlife Refuge Comprehensive Conservation Plan
- Spring Mountain National Recreation Area Management Plan

- Department of Defense-Partners in Amphibian & Reptile Conservation Strategic Plan
- Habitat Management Guidelines for Southwestern Amphibians and Reptiles in the US
- Priority Amphibian and Reptile Conservation Areas plan
- Inventory and Monitoring: Recommended Techniques for Reptiles and Amphibians
- Recommended Framework for Utilizing Volunteers to Conduct Surveys for Non-calling Herpetofauna
- State of the Union: Legal Authority Over the Use of Native Amphibians and Reptiles in the US

Federal & State Agencies

- Bureau of Land Management
- U.S. Fish and Wildlife Service (Ecological Services Office, Desert NWR Complex, Desert Tortoise Recovery Office)
- Department of Defense
- Department of Energy
- National Park Service (Lake Mead NRA)
- U.S. Geological Survey (Biological Research Division)
- U.S. Forest Service
- U.S. Bureau of Reclamation
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Transportation

Conservation Organizations

- The Nature Conservancy
- Sierra Club
- Desert Tortoise Conservation Center/San Diego Zoo Global
- Las Vegas Springs Preserve
- National Audubon/Red Rock Audubon Society
- Southern Nevada Herpetological Society

Other Key Partners

- Clark County
- Nye County
- Lincoln County
- University of Nevada
- Partners In Flight
- Great Basin Bird Observatory
- Partners in Amphibian and Reptile Conservation
- Local Town Boards
- Off-Highway Vehicle Organizations
- Sportsman’s Organizations
- Moapa Band of Paiutes

Focal Areas

- Amargosa Desert
- Black Mountains
- Bullfrog Hills
- El Dorado Mountains
- Indian Springs Valley
- Las Vegas Valley
- Las Vegas Wash
- Lower Meadow Valley Wash
- McCullough Range
- Moapa Valley -West
- Moapa Valley-East
- Muddy Mountains
- Oasis Valley
- Pahranagat Valley
- Pahrump Valley
- Piute Valley
- Spring Mountains
- Virgin River Valley
- White Basin

Desert Tortoise Photo Courtesy of P. Conrad

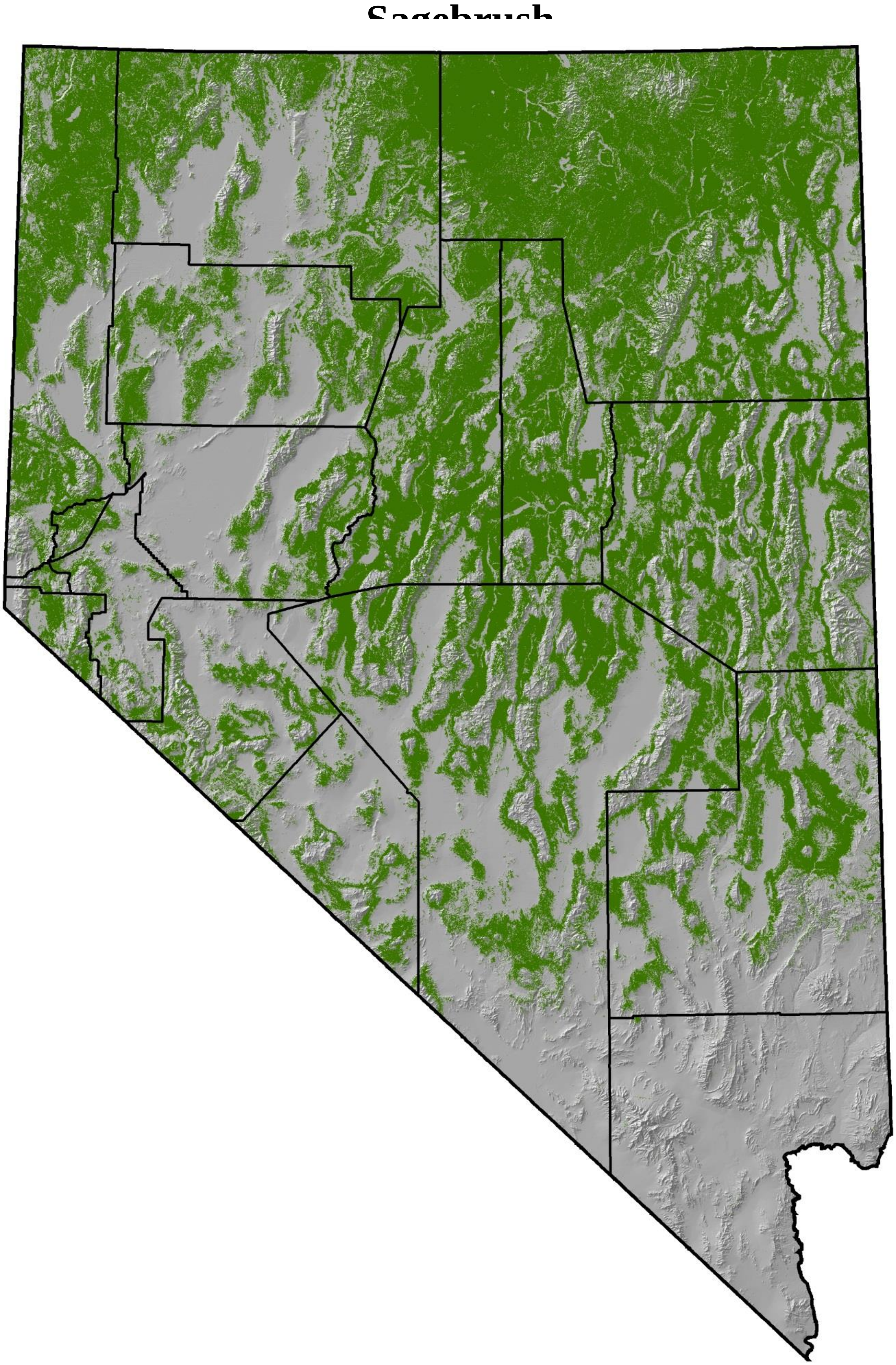


Figure 8. Distribution of Sagebrush in Nevada.

KEY HABITAT: SAGEBRUSH

Things to Know….

- Sagebrush habitats are found 4,500-10,000 feet, from valley bottoms to mountains, and are generally mixed with other habitats throughout the Great Basin.
- Several priority species, including Greater Sage-grouse, pygmy rabbit, Sage Thrasher, and sagebrush vole have evolved in this habitat and are predominantly if not wholly dependent upon it.
- Largest habitat threat is habitat conversion due to various processes such as human activity, fire, and invasive plants.
- The montane sagebrush steppe mountain habitat is most vulnerable to climate change transition to cheatgrass invasion and conversion to other sagebrush types.
- Prescriptive actions include mechanical removal of pinyon-juniper and prescribed fire.

Ecoregions

Southwest ReGAP 2005

Great Basin	9,564,434 hectares	23,615,888 acres
Columbia Plateau	3,743,539 hectares	9,243,305 acres
Mojave	89,651 hectares	221,361 acres
Sierra Nevada	7,194 hectares	17,763 acres
Total	13,404,818 hectares	33,098,316 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Wyoming Big Sagebrush…………………	S054 Intermountain Basins Big Sagebrush Shrubland
Low-Black Sagebrush………………………	S055 Great Basin Xeric Mixed Sagebrush Shrubland
Low Sagebrush Steppe…………………….	
Big Sagebrush Upland………………………	S071 Intermountain Basins Montane Sagebrush Steppe
Montane Sagebrush Steppe Mountain…	
Big Sagebrush Steppe………………………….	S078 Intermountain Basins Big Sagebrush Steppe

Key Habitat Description

Sagebrush generally occurs throughout the Great Basin and is most common in valleys and mountain ranges north of the Mojave Desert, although it does occur in the Mojave Desert ecoregion mostly in mid-elevation drainages and old burn scars of blackbrush shrublands, and higher on mountain ranges. Sagebrush types are generally found in a mosaic with other habitat types but can occur as large monotypic expanses. Sagebrush habitats generally occur between 4,500 and 10,000 feet, and are widespread throughout valley, foothill, and mountain environments. Annual precipitation ranges from 20 to 76 cm, mostly in the form of snow, and temperatures range from -30 to 110 degrees F. Overstory structure can range from 15 cm high or less in sagebrush sites on exposed, rocky slopes, to two to three meters high in drainages where basin big sagebrush has extended its roots into the water table. Sagebrush canopy, however, generally ranges between 60 and 90 cm high. Crown cover may vary from one to nearly 70%, but most commonly in the 20 to 40% range.

There are some 27 recognized species and distinct subspecies of sagebrush in Nevada. Dominant species include basin big sagebrush, mountain big sagebrush, Wyoming big sagebrush, low sagebrush, and black sagebrush (Cronquist et al. 1994). Co-dominant plant species include bitterbrush, snowberry, rabbitbrush, snakeweed, white sage, spiny hopsage, bluebunch wheatgrass, bluegrass, needle and thread, Idaho fescue, Indian ricegrass, Great Basin wildrye, Indian paintbrush, lupine, buckwheat, globemallow, and penstemon. Trees most often associated with the type include Utah juniper, western juniper, and pinyon pine. The altitudinal distribution of sagebrush generally follows a pattern of basin big sagebrush in the valley floors or lower alluvial fans, Wyoming big sagebrush at the mid-elevations, and mountain big sagebrush typically encountered above 6,500 feet. Low and black sagebrush are both low-growing shrubs that rarely exceed heights of 15 inches, found primarily on shallow or poorly drained soils with a root restricting layer, interspersed throughout the greater sagebrush expanse in many elevation bands.

The TNC Biophysical Settings involving sagebrush are described below:

Wyoming Big Sagebrush – represents the semi-desert type below the 25-cm (10-inch) precipitation zone, which is too dry for pinyon and juniper, most of what is normally considered “Wyoming Big Sagebrush” by the resource management community.

Big Sagebrush Upland – combines the upland soils of most of what is normally considered “Wyoming Big Sagebrush” by the resource management community between 25+ cm (10+ inch) and 30 cm (12 inch), and the upland soils of what is normally considered “mountain big sagebrush” between 30 cm (12 inch) and 36 cm (14 inch) of precipitation. The upland soils of Wyoming and mountain big sagebrush contain the hybrid of the two subspecies and have the same susceptibility to cheatgrass and pinyon-juniper encroachment, and both subspecies respond similarly to management actions.

Montane Sagebrush Steppe Mountain – subalpine sagebrush above the 14-inches per year precipitation zone. The upper reaches of what is normally called “mountain big sagebrush.”

Low-Black Sagebrush – low-growing shrubs that rarely exceed heights of 15 inches, found primarily on shallow or poorly drained soils with a root restricting layer, interspersed throughout the greater sagebrush expanse in many elevation bands.

Low Sagebrush Steppe – Low sagebrush above the 14-inch precipitation zone with a substantial grass component (often co-dominant with sagebrush in excellent condition) of bluebunch wheatgrass or Thurber’s needlegrass.

Big Sagebrush Steppe – open canopy sagebrush with significant grass understory with Idaho fescue as an indicator species. Primarily found on the Columbia Plateau.

Value to Wildlife

Because Nevada encompasses the heart of the “sagebrush ocean,” it naturally assumes high stewardship responsibility for the species of wildlife that have evolved specifically to thrive in sagebrush habitats. In Nevada, eight species are predominantly dependent on sagebrush habitat for most of their life history needs: pygmy rabbit, Great Basin pocket mouse, sagebrush vole, sagebrush lizard, Greater Sage-Grouse, Sage Thrasher, Brewer’s Sparrow, and Sage Sparrow (the last three also occur as breeding species in cold desert scrub, but to a much lesser degree).

The Greater Sage-Grouse is probably the species most extremely adapted to the use of sagebrush itself. Sage-Grouse are equipped with a specially-designed grinding organ that fuses the crop and the gizzard to address the difficult challenges of digesting sagebrush herbaceous matter. The year-round diet of the adult Sage-Grouse consists of 98% sagebrush leaves, which gives the bird the ability to winter on sagebrush range.

Sage-Grouse nest on the ground under low-growing sagebrush bushes enhanced with thick bunchgrass understory. Sage Thrashers, Brewer's Sparrows, and Sage Sparrows depend heavily on the shrub component for nesting substrate, and their distribution is closely tied with that of sagebrush. Pygmy rabbits also prefer the taller big sagebrush that grows on deeper soils, but their occurrence is governed more by the presence of the deep soils (for burrowing) than by the tallness or character of the shrubs.

Sagebrush range in good condition also supports a lush undergrowth of bunchgrasses and forbs. The presence of this highly productive understory is critical to the needs of other wildlife species, including the sagebrush vole. The various shrew species that live in sagebrush are insectivores, but they depend on the productivity of the herbaceous component for the abundant production of their prey items, as well as for cover.

Several species nest on habitats adjacent to sagebrush habitat, but spend most of their hunting time over sagebrush range where they primarily prey on ground squirrels and jack rabbits (e.g., Prairie Falcons on cliffs and rimrock, and Ferruginous Hawks on the pinyon-juniper edge or sometimes on rimrock). In eastern Nevada, Bald Eagles winter on sagebrush valley bottoms in widely scattered singles or pairs, preying chiefly on jack rabbits – somewhat of a deviation from their normal expected wintering strategies (fish and waterfowl). The reptile Species of Conservation Priority found in sagebrush are considered to be habitat generalists, but it is important to note that the recent taxonomic split of the pygmy short-horned lizard (*Phrynosoma douglasii*) from the greater short-horned lizard (*P. hernandesi*), could have significant implications regarding the importance of sagebrush to the maintenance of the pygmy short-horned lizard. To date, the occurrence and distribution of pygmy short-horned lizard is only beginning to be studied in Nevada, and it has been verified on Sheldon National Wildlife Refuge in the northwest corner of the state.

Key Elements of Sagebrush Habitat Important to Wildlife

MATURE SHRUB – nesting structure, protection from predators, thermal cover

Greater Sage-Grouse
Loggerhead Shrike
Sage Sparrow
Brewer's Sparrow
Sage Thrasher

EARLY/MIDSERAL SHRUB – foraging, protection from predators, thermal cover

mule deer

TALL BIG SAGE/DEEP SOILS – burrowing, protection from predators, foraging

pygmy rabbit

GRASSES/FORBS – nesting cover, foraging

Greater Sage-Grouse
Columbian Sharp-tailed Grouse

sagebrush vole
Merriam's shrew
Preble's shrew

SANDY SOILS – burrowing, protection from predators
Burrowing Owl
dark kangaroo mouse
pale kangaroo mouse

MESIC SITES – foraging
Inyo shrew
Sage Thrasher

WOODLAND/ROCK ECOTONE – nesting, foraging
Ferruginous Hawk

PREY POPULATIONS – feeding on species in this habitat
Ferruginous Hawk
Bald Eagle
Prairie Falcon
desert horned lizard
greater short-horned lizard
pygmy short-horned lizard

GENERALISTS – using a variety of elements in multiple habitats
Wyoming ground squirrel

Existing Environment

Land Uses

- Livestock grazing
- Motorized recreation
- Non-motorized recreation
- Recreation development
- Mineral/oil/gas extraction
- Wind energy development
- Utility rights-of-way
- Urban/suburban development
- Industrial Development
- Road Development
- Military mission
- Waste and hazardous materials disposal
- Species harvest

Habitat Conditions

Much of the basin big sagebrush and Wyoming big sagebrush range in Nevada currently lacks understory of native bunchgrasses and forbs that were historically present. Shrub cover has increased from what are generally regarded as Pre-Settlement conditions, and non-native annual grasses, most notably cheatgrass, have invaded big sagebrush range, bringing with them an accelerated fire interval for which sagebrush regeneration cannot compensate. Low and black sagebrush are being similarly invaded by cheatgrass throughout the state and by medusahead in northern Nevada, which an aggressive exotic grass that can tolerate the shallow clay soils of these range sites and can cause a similar negative impact through altered fire regime is threatening the low sagebrush landscape. Overall, a temporal conversion from shrubland with high species diversity to annual grassland with drastically reduced wildlife value is occurring.

Pinyon and juniper expansion into shrubland has thrived since range overgrazing in the 19th Century and continuing in the first half of the 20th Century (Young and Sparks 2002), and fire suppression after the 1920s (Blackburn and Tueller 1970; Pyne 2004). Many true woodlands within a few miles of mines were harvested or thinned during the historic mining era of the late nineteenth century, but many woodlands have re-populated the soils that supported them and continue to aggressively contribute to the expansion of trees into sagebrush range. Pinyon and juniper expansion into sagebrush range drastically alters range structure and creates conditions difficult to restore to pre-invasion expression. Pinyon-juniper expansion is also generally facilitated by regional warming (Grayson, 1993; Tausch and Nowak 1999). Currently, there is considerable discussion in Nevada concerning the need to manipulate the balance between woodland expansion and healthy sagebrush community maintenance in light of the recent effort to list the Greater Sage-Grouse under the Endangered Species Act.

This combination of major habitat type conversions is rapidly depleting and fragmenting the expansive "sagebrush ocean." New road development, existing road improvement, and urban/suburban and industrial development are also contributing to depletion and fragmentation. Increased human population in several areas of the State has exerted increased pressure on the landscape, and thus sagebrush community integrity will continue to be challenged over time.

Problems Facing the Species and Habitats

Loss of habitat to the various conversion processes currently exerting pressure on sagebrush habitat results in reduced living space for the wildlife that depend on it. Where sagebrush habitat has been depleted of its understory, it lacks the ability to provide nesting cover, escape cover, and sources of food to herbivorous and granivorous animals. Lack of nesting and escape cover coupled with increasing human infrastructure (roads, utility rights-of-way), that not only create travel lanes for mammalian predators and perch sites for avian predators, but also serves to fragment the landscape into smaller and smaller patches, may be facilitating the success of predators at the expense of other species such as ground-nesting birds. Predation pressure may be reaching effect levels on a suite of sagebrush residents, including Greater Sage-Grouse. Increased human activity on the land is leaving in its path a footprint of habitat degradation in the form of a broken-down shrub layer, loss of species diversity, and increased soil erosion that reduces site restoration capability.

The U.S. Breeding Bird Survey (BBS) documented a population decline of 50% or greater for Brewer's Sparrow between 1966 and 1999. The PIF North American Landbird Conservation Plan has identified Brewer's Sparrow as a Watch List Species in need of Management Action in the Intermountain Bird Conservation Region due to the significant population decline. Loggerhead Shrikes continue to decline significantly across its range in North America and the Sage Thrasher continues to exhibit significant declines in neighboring states, although showing signs of stabilizing in Nevada and Great Basin-wide.

Predicted Climate Change Effects

Big Sagebrush Steppe

The Big Sagebrush Steppe BpS currently occurs predominantly in the northern regions – Black Rock, Owyhee, and Elko. In those regions, Big Sagebrush Steppe is relatively intact (+75% in characteristic classes), but in the Black Rock Plateau and Owyhee Desert regions, sagebrush steppe is heavily weighted in percentage toward the mid-closed class with shrub cover ranging between 31 and 50%. In the Elko region, Big Sagebrush Steppe occurs predominantly in the mid-open class under 30% shrub cover. The percentage that would roughly represent its mid-closed class in reference condition (18%) is currently classified as rabbitbrush (early shrub – 22%). The open bunchgrass-dominated stage is largely deficient under current conditions. The 50-year climate change projections predict increases in transition to uncharacteristic classes for these regions: 26% in Elko, 45% in Black Rock, and 54% in Owyhee. Increases in the annual grass class are predicted to stay below 20% for each of these regions and tree encroachment (above 20% cover) is predicted to occur in about 14% of the Black Rock and Owyhee regions, but only one percent in the Elko region.

TNC climate change modeling predicts the appearance of Big Sagebrush Steppe in several regions south of the Columbia Plateau in 50 years, including the Calcareous Ranges, Eastern Sierra, Eureka, Humboldt Ranges, Lahontan Basin, Toiyabe, Tonopah, and Walker Corridor. Predicted acreages gained in each region are presented in Appendix C. Big Sagebrush Steppe will be converted primarily from the Montane Big Sagebrush Mountain BpS above what is now the 14-inch precipitation elevation. These converted acreages will be significantly invaded with annual grasses, ranging anywhere from 36 to 84% in uncharacteristic classes, mostly occurring in the shrub-annual-perennial class. All but Eastern Sierra (36%) will be over 50% invaded.

Big Sagebrush Upland

Big Sagebrush Upland occurred in all 13 regions evaluated by TNC. In reference condition, Big Sagebrush Upland should exhibit 84-86% of its total acreage in the early, mid-open, and mid-closed classes. The early class (10-80%, 0-10 percent shrub) is almost non-existent throughout its range, deficient anywhere from 75-100% in all regions. Most regions also exhibit a significant transition from the mid-open class to the mid-closed and late-open/closed classes, indicating that sagebrush age in this BpS is weighted toward the high end with little natural rejuvenation. This is because throughout most of this BpS, stand-clearing events (e.g. fire) are almost always significantly followed by the invasion of annual grasses.

Significant transitioning into uncharacteristic classes has already occurred in most of those regions (Appendix C), particularly the northern half of the state where percentage in U-classes currently range from 41 to 81%, with the exception of the Owyhee (23%) and Eastern Sierra (20%) regions. In the three southern regions plus the Walker Corridor, U-class percentages currently range from eight to 34%.

Climate change modeling indicated that the greatest increases in U-class percentages would occur in those southern regions not currently so advanced in transition, ranging from 13 to 57%. The remaining eight northerly regions increased in U-class percentage less than 10% in 50 years with climate change.

Low-Black Sagebrush

The Low-Black Sagebrush BpS occurs in all 13 regions evaluated by TNC. In reference condition, Low-Black Sagebrush should exhibit 15-20% in the early class, 40-50% in the mid-open class, and 30-40% in the late-open/closed classes. Low-black sagebrush in current condition exhibits a healthy 40 to 75% in the mid-open class, but early and late classes are invaded by annual grasses with some tree encroachment occurring on the eastern and western borders of the state.

Climate change modeling indicated that four of the 13 regions would increase in uncharacteristic class percentages over 10 percent in 50 years (Appendix C), four would increase over 20%, and four would increase over 30%, with the Mojave region transitioning to a total of 47% into U-classes. The eastern side of the state (Elko, Calcareous, and Clover regions) would experience relatively small increases, but are largely transitioned to U-classes already (60-75%). The Black Rock and Owyhee regions would remain relatively intact, starting below 25% currently and experiencing 12-13% increases in U-classes in 50 years.

Low Sagebrush Steppe

The Low Sagebrush Steppe BpS occurs at high elevations in nine of the 13 regions, absent in the Lahontan Basin, Walker Corridor, Tonopah, and Mojave regions. Low Sagebrush Steppe currently exists in relatively good condition in its northern range (Black Rock, Owyhee, Elko regions) with less than five percent in uncharacteristic classes. Throughout the rest of its Nevada range, the type is already heavily invaded by annual grasses and/or tree-encroached.

Climate change modeling indicated that the northern regions with good condition Low Sagebrush Steppe listed above would transition 12% or less to U-classes in 50 years (Appendix C). Across the rest of its range, the type would not transition much further into U-classes, but in the Eureka and Toiyabe regions where current U-class percentage already tops 80%, the remaining amount would transition to U-class, while the Humboldt Ranges are predicted to lose their Low Sagebrush Steppe acreages completely in 50 years.

Montane Sagebrush Steppe Mountain

The Montane Sagebrush Steppe Mountain BpS occurs in all 13 regions above the 14-inch precipitation zone and constitutes the upper-elevation element of what is commonly referred to in Nevada as “mountain big sage.” The type is currently significantly departed from reference conditions in most regions throughout the state without a strong pattern of departure comparable between regions or regional trends (e.g. north, south, east, west, etc.) that can be generally represented. U-class percentages range from 17 (Owyhee Desert) to 81% (Appendix C). Characteristic classes which should be ranging around 45% in the mid-open class are weighted more in the mid-closed and late classes in 10 of 13 regions. Acreage in the early class is almost non-existent, reflecting the continued lack of enough fire activity. The BpS is very productive and should easily recover from fire.

Climate change projections predicted all but two regions (Owyhee and Eastern Sierra) would be over 40% transitioned to uncharacteristic classes in 50 years. The largest transitions tended to occur in the southerly regions (Mojave, Clover, Calcareous, Tonopah, Walker Corridor).

Climate change modeling predicted significant conversion of this BpS to either Big Sagebrush Upland or Big Sagebrush Steppe. Predicted losses by region are reported in Appendix C. Predicted losses in the Montane Sagebrush Steppe Mountain BpS mostly run between 18 and 22% of its current totals in all regions, with the exceptions of the Elko and Mojave regions (12 and 14%, respectively).

Wyoming Big Sage

Wyoming Big Sage occurs in all the evaluated regions except the Mojave. Currently the type is significantly departed from reference conditions in all regions except the Owyhee Desert, where only one percent was classified in any uncharacteristic class (Appendix C). With respect to the distribution of the type between characteristic classes in the Owyhee, there is no early class and significant invasion by annual grass or juniper is not yet occurring. All other regions are currently exhibiting greater than 50% of their acreage of Wyoming Big Sage in uncharacteristic classes, some as high as 90%. For most regions, the bulk of the U-class acreage occurs in the tree-annual grass class and in the Elko region most of the U-class acreage occurs in rabbitbrush – both rather unfriendly habitats to sagebrush-associated wildlife species. Four regions (Eastern Sierra, Eureka, Humboldt, and Owyhee Desert) were predicted to increase in U-class percentage over 10% in 50 years with climate change. Only Owyhee, Elko, and Eastern Sierra will remain under 60% transitioned to U-classes in 50 years.

Possible Wildlife Responses to Climate Change

Sagebrush communities in their characteristic forms provide essential habitat elements for wildlife in several critical ways. The shrub component provides essential nesting structure, protection from the elements (thermal cover), and protection from predators (escape cover). The native grass/forb understory provides food for herbivorous/granivorous species, including the important upland forbs for early Greater Sage-Grouse brood-rearing immediately after hatch. Rodents such as sagebrush vole, pale and dark kangaroo mouse, and Wyoming ground squirrel are dependent on the herbage, fruits, and seeds of native grasses and forbs. The native understory is also important to the sustenance of abundant, diverse arthropod communities important as food sources for reptiles such as the greater and pygmy short-horned lizards, insectivorous mammals such as Merriam's, Preble's, and Inyo shrew, as well as all the brood-rearing songbirds including Sage Thrasher, Brewer's Sparrow, Sage Sparrow, and Loggerhead Shrike. In turn, several of these species are preyed upon by predators, including Burrowing Owl, Ferruginous Hawk, Bald Eagle, and Prairie Falcon.

Predicted high ecological departure in sagebrush communities suggests disruption of many ecological processes required by wildlife species. Primary threats to ecological integrity are the invasion of annual grasses and exotic forbs via wildfire, land disturbance, and the encroachment of pinyon and juniper trees from their characteristic sites primarily through natural seed dispersal and fire suppression. Invasive grasses and forbs change the community through the eventual replacement of the native understory with species whose seeds and herbage are of less nutritional value and are available in nutritious form for a shorter period of time compared to the native understory. Eventually, through the change in fire regime facilitated by annual grass/exotic forb build-up and their better recovery advantage after fire, the shrub component can be lost and the site converted to an annual grass/exotic forbland with little natural recovery potential. Tree encroachment will start a disruptive process that several sagebrush breeding birds, including Sage Thrasher, Brewer's Sparrow, and Sage Sparrow, avoid in surprisingly early stages of advancement – as low as six percent tree cover for Sage Thrashers (Reinkensmeyer, 2000) and around 15% for Brewer's Sparrow (CalPIF, 2005). GBBO bird response analysis predicted that among three species – Sage Thrasher, Brewer's Sparrow, and Sage Sparrow – Sage Sparrow demonstrated the greatest negative sensitivity to presence of trees, with reductions in densities ranging between 87 and 89% from absence of trees to presence of trees (GBBO, 2011). Similarly, the Connectivity Study Group Report predicted a 29% reduction in area occupied by Sage Thrasher, 18% reduction in area occupied by Sage Sparrow, and an 11% reduction in area occupied by Brewer's Sparrow as pinyon-juniper woodland expanded (Fleishman et al., 2012). Small mammal and reptile response to tree encroachment into sagebrush has been less studied, but intuition would suggest that these species would maintain their occurrence as long as a native understory and some of the shrub component persist. Tree encroachment can reach a point to where the understory is deprived of sufficient water by the tree root systems and disappears, as reflected in the Uncharacteristic Tree-encroached (U-TE) class description for several sagebrush communities in this analysis.

An evaluation of the relative values of the different classes of sagebrush leads to the identification of uncharacteristic classes that will have definite impacts on wildlife's ability to stay on the landscape. For the purposes of this analysis, we have identified the following classes as unsatisfactory to sagebrush-associated wildlife: annual grassland, early shrub (rabbitbrush), tree-annual grass, and tree-encroached. The characteristic early classes (usually resultant from a stand-changing event such as wildfire or applied management) can be expected to be abandoned by shrub-associated wildlife species for the first 12 or so years, but since this is a natural rejuvenation process and the sagebrush community is on track for natural succession, it is a stage that results in long-term benefits for the sagebrush wildlife community. The depleted and shrub-annual grass-perennial grass classes will likely continue to hold the shrub-nesting birds such as Sage Thrasher, Brewer's Sparrow, and Sage Sparrow which seem to be non-responsive to changes in understory condition as long as the shrubs persist, particularly in their mature stages. Greater Sage-Grouse should conceivably find the depleted and shrub-annual grass-perennial grass classes acceptable as wintering habitat as the understory would be under the snow, but assign lower suitability to the depleted class during nesting summer foraging. The lack of understory impacts nesting success through increased nest predation (Coates and Delehanty, 2010) and lack of herbaceous material and associated herbivorous insects would impact brood nutrition in the first few weeks after hatch (Klebenow and Gray, 1968; Gregg et al., 2008). It is possible that the ground-dwelling small mammals and possibly the reptiles are negatively impacted by the loss of understory in the depleted classes, but research is lacking in this regard.

Cumulative increases in the annual grass, early shrub, and tree-encroached classes of sagebrush types after 50 years of climate change consistently ran between 10 and 25% when summed for each region with some notable exceptions. In the Mojave region where sagebrush types are more typically montane or associated with montane dry washes, and largely restricted to the Spring Mountains and Sheep Range, the cumulative increase in wildlife-unfriendly sagebrush classes reached 58% for Big Sagebrush Upland (affecting 9,200 acres), 64% for Low/Black Sagebrush (affecting 90,000 acres), and 65% for Montane Sagebrush Steppe Mountain (affecting 8,300 acres). The bulk of these increases were predicted to occur in the early shrub class (rabbitbrush), presumably following wildfire. The Lahontan region was predicted to transition an average of 46% of all its sagebrush communities to unsuitable classes in 50 years, while the Humboldt Ranges were predicted to transition 34% and the Clover region 30% to unsuitable classes. Large transitions in the Lahontan and Humboldt Ranges regions might particularly target Sage Sparrow as a species that is more prevalent in the Wyoming Big Sage BpS than in other types of sagebrush. Pygmy rabbits might particularly suffer range retractions in those two regions where nearly all types of big sagebrush were predicted to transition over 40% to unsuitable classes.

Generally, sagebrush-associated species in Nevada could experience a 10 to 30% decrease in acres of suitable habitat over the next 50 years with climate change. GBBO bird population modeling predicted a 14% reduction in statewide population for Brewer's Sparrow, 20% for Sage Sparrow, and 21% for Sage Thrasher based on the TNC climate change analysis. Whether or not populations will be able to adjust to greater densities in reduced suitable habitat, thus maintaining their current levels remains to be seen and should be monitored. Evidence suggests that nesting sagebrush songbirds do have demographic capabilities to nest at densities higher than they typically do when unstressed for space (Nevada Bird Conservation Plan, 2010). How mammals and reptiles might respond to such reductions is largely unknown and should be monitored.

Taking Prescriptive Action

Prescriptive actions for sagebrush habitats are complex. For a more detailed discussion, please see Appendix C.

Priority Research and Monitoring Needs

- Develop species/habitat relationship models for small mammal and reptile Species of Conservation Priority in sagebrush, with special attention to species response to changes in understory, removal of

the shrub component, species response to rabbitbrush dominance, and incremental changes in annual grass dominance and pinyon/juniper encroachment.
- Develop a survey/inventory and occupancy/trend program for pygmy rabbit and Ferruginous Hawk.
- Continue occupancy/trend survey for mice, voles, and shrews of Conservation Priority.

Conservation Strategy

Goal: Thriving self-sustaining wildlife populations in healthy sagebrush communities on stable soils; vigorous, structurally diverse shrub component in various age classes; vigorous, diverse self-sustaining understory of native grasses and forbs.

Objective: Prevent the transitioning of sagebrush communities to annual grass classes from exceeding 20% total area through 2022.

Action: Support current efforts to develop biological control agents for the management of cheatgrass and red brome.

Action: In collaboration with the BLM and Forest Service, update fire response plans for all districts using the latest information gathered from collaborative wildlife conservation planning efforts such as the Governor's Sage Grouse Conservation Team. Prioritize areas for rapid fire response; set fire response objectives for all lands in a district.

Action: In collaboration with BLM and Forest Service, update range rehabilitation contingency plans to reflect collaborative wildlife conservation planning priorities.

Action: Incorporate specific, quantified wildlife objectives into fire rehabilitation projects to qualify for NRCS private lands assistance programs.

Objective: Prevent the transitioning of sagebrush communities to pinyon-juniper encroachment from exceeding 20% total area through 2022.

Action: Through coordinated resource planning processes (comprehensive stakeholder involvement operating by consensus), design a science-based pinyon-juniper management strategy that responsibly reclaims sagebrush lands from pinyon-juniper invasion where accepted site potential interpretations do not support pinyon-juniper occurrence, yet maintains sufficient high-quality pinyon-juniper wildlife habitat at the mountain range scale.

Action: Using soil site potential, identify sites where pinyon-juniper has clearly invaded sagebrush range; determine current site potential for restoration; prioritize restoration projects based on computed potential wildlife benefit.

Action: Develop and implement a stand treatment prioritization process that weighs the degree of invasiveness of a stand against its relative wildlife habitat value. Stands prioritized for treatment would rate highest in imminent threat from invasiveness and lowest in relative wildlife habitat value.

Action: Determine project sideboards (e.g., protection of adjacent mountain mahogany stands; protection of identified high-quality pinyon-juniper wildlife habitats); apply pinyon-juniper treatment using methods posing the least potential threat and greater potential benefit to adjacent habitats at-risk (e.g. those described above).

Action: Apply necessary sagebrush plant community restoration techniques; protect from site and plant community disturbance for the time necessary to assure recovery; monitor results and wildlife response

Objective: Apply restoration treatment to 2 million acres of degraded sagebrush habitat by 2022.

"apply restoration treatment" – including but not limited to pinyon-juniper removal, application of herbicide to annual grass, brush-beating, prescribed fire, changes in grazing prescriptions – any proven prescription intended to start a transition from current degraded conditions toward healthier range (plant community) conditions.

"2 million acres" – target set by the Nevada Partners for Conservation and Development (NPCD)

Action: Using scientifically-informed collaborative processes, assess plant community structure and diversity to better define habitat quality for the full range of wildlife species using sagebrush.

Action: Using state-of-the-art scientific knowledge such as current range states/transition theory, and working through collaborative stakeholder processes, develop a proactive strategy for the judicious application of sagebrush management treatments to rejuvenate habitat and minimize risk of plant community breakdown and exotic plant invasion.

Action: Improve understory condition and diversity of native forb communities through progressive grazing management.

Action: Continue support and facilitation of the Nevada Partners for Conservation and Development (NPCD), a collaborative forum for the design, leveraged funding, and implementation of the best available large spatial and temporal scale habitat projects.

Action: Continue to foster and participate in the growth of local working groups across the state who are using their on-the-ground knowledge to design and implement range restoration projects.

Objective: Maintain birds of conservation priority at stable or increasing trend through 2022.

"birds of conservation priority" – Greater Sage-Grouse, Loggerhead Shrike, Sage Sparrow, Brewer's Sparrow, Sage Thrasher, Columbian Sharp-tailed Grouse, Western Burrowing Owl, Ferruginous Hawk

"stable or increasing trend" - "stable or increasing trend" – as measured by Nevada Bird Count, USGS Breeding Bird Survey, or raptor nest monitoring (Ferruginous Hawk).

Action: Continue to adopt the objectives and conservation strategies of the Greater Sage-Grouse Conservation Plan for Nevada and Eastern California and integrate Sage Grouse Plan activities into implementation of the Wildlife Action Plan.

Action: Adopt sagebrush bird species conservation strategies as outlined in the Nevada Comprehensive Bird Conservation Plan (2010).

Action: Apply sagebrush restoration techniques that involve mechanical or chemical removal of decadent-aged sagebrush overstory on the landscape in a rotation scheme that leaves untreated decadent sagebrush overstory for nesting use by Sage Thrashers, Sage Sparrows, and Brewer's Sparrows through the complete recovery of the earliest-treated sites to occupied habitat.

Objective: Maintain populations of small mammals of conservation priority at current detection levels in suitable habitat through 2022.

"small mammals of conservation priority" – pygmy rabbit, sagebrush vole, dark kangaroo mouse, pale kangaroo mouse, Merriam's shrew, Preble's shrew, Inyo shrew

"current detection levels" - as measured via statewide Wildlife Action Plan Sagebrush Performance Indicators survey (2010) annually or at scheduled intervals not to exceed five years.

Action: Continue to conduct the Wildlife Action Plan Sagebrush Performance Indicators survey.

Action: Conduct an inventory of shrews to delineate distribution and determine relative abundance in sagebrush.

Action: Develop habitat relationship models for small mammals of conservation priority to determine relative importance of understory to sagebrush vole occupancy, relative extent of dark and pale kangaroo mouse use of sagebrush habitats, and the responses of all priority mammals to annual grass and/or pinyon-juniper invasion into sagebrush.

Objective: Maintain populations of Great Basin collared lizard, long-nosed leopard lizard, and desert horned lizard at stable or increasing trend through 2022.

"stable or increasing trend" – as measured by ocular reptile survey (yet to be developed) conducted annually or at scheduled intervals not to exceed five years.

Action: Develop a survey project that monitors local impacts of commercial reptile collection on key favored collection areas. Make changes in live harvest regulations according to monitored and demonstrated need.

Objective: Maintain populations of greater short-horned lizard and pygmy short-horned lizard at detectable levels through 2022.

"detectable levels" – as determined by regularly scheduled surveillance monitoring (ocular or pit trap survey) conducted at intervals not to exceed five years.

Action: Develop and field test habitat suitability models for greater and pygmy short-horned lizard and monitor specific effects of climate change on their habitats, particularly the impacts of annual grass invasion on ant species composition and secondary impacts on horned lizard feeding habits.

Objective: Protect wildlife and wildlife habitat through planning, project review, and GIS support through 2022.

Action: Meet or exceed identified review periods for projects that come through the state clearinghouse or directly from agencies.

Action: Implement the provisions of AB308 (Energy Development Project Review legislation).

Action: Participate in the Great Basin and Desert LCCs, the BLM Rapid Ecological Assessments (REAs), and the Southwest Science Climate Center (CSC).

Action: Develop and implement the Western Governor's Association Crucial Habitat Assessment Tool (CHAT) in Nevada and coordinate with the other western states on regional implementation.

Action: Enhance NDOW's GIS capacity to fully meet the needs of NDOW staff, federal partners, non-governmental organizations, and project proponents.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	77
Private	14
U.S. Forest Service	5
U.S. Fish & Wildlife Service	1
Tribal	1
All Others	2

Existing partnerships, plans, and programs

Multi-partner
- Governor's Greater Sage-Grouse Conservation Team and local Sage Grouse working groups
- Eastern Nevada Landscape Coalition
- Great Basin Restoration Initiative
- Eastern Nevada Landscape Restoration Project

Federal & State Agencies
- Bureau of Land Management
- U.S. Forest Service
- U. S. Fish and Wildlife Service
- Natural Resources Conservation Service/Nevada Conservation Districts

- Nevada Department of Wildlife
    - Nevada Partners for Conservation and Development
- Nevada Division of Forestry

Conservation Organizations

- The Nature Conservancy
- National Audubon Society/Lahontan Audubon Society
- Sierra Club

Sportsmen's Organizations

- Mule Deer Foundation
- Rocky Mountain Elk Foundation
- Nevada Bighorns Unlimited
- Fraternity of the Desert Bighorn

Bird Initiatives

- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight

Other Key Partners

- Counties
- Native American tribes
- Mining Industry/Nevada Mining Association
- University of Nevada – UNR, Cooperative Extension
- Intermountain West Joint Venture

Focal Areas

Adobe Range	Railroad Valley	Upper Reese River Valley
Buffalo Hills	Ruby Mountains	
Butte Valley	Ruby Valley	
Clan Alpine Mountains	Salmon Falls Creek Area	
Granite Range	Salmon River Range	
Huntington Valley	Santa Rosa Range	
Independence Mountains	Sheldon NWR	
Jarbidge Wilderness	Shoshone Basin	
Kobeh Valley	Simpson Park Mountains	
Little Smokey Valley	Snake Mountains	
Madelin Mesa	Spring Valley	
Marys River Drainage	Spruce Mountain	
Monitor Valley	Steptoe Valley	
Owyhee Desert (So. Fork Owyhee drainage)	Toiyabe Range	
Owyhee River area	Toquima Range	
Pancake Range	Tuscarora Mountains	

Lower Montane Woodlands & Chaparral

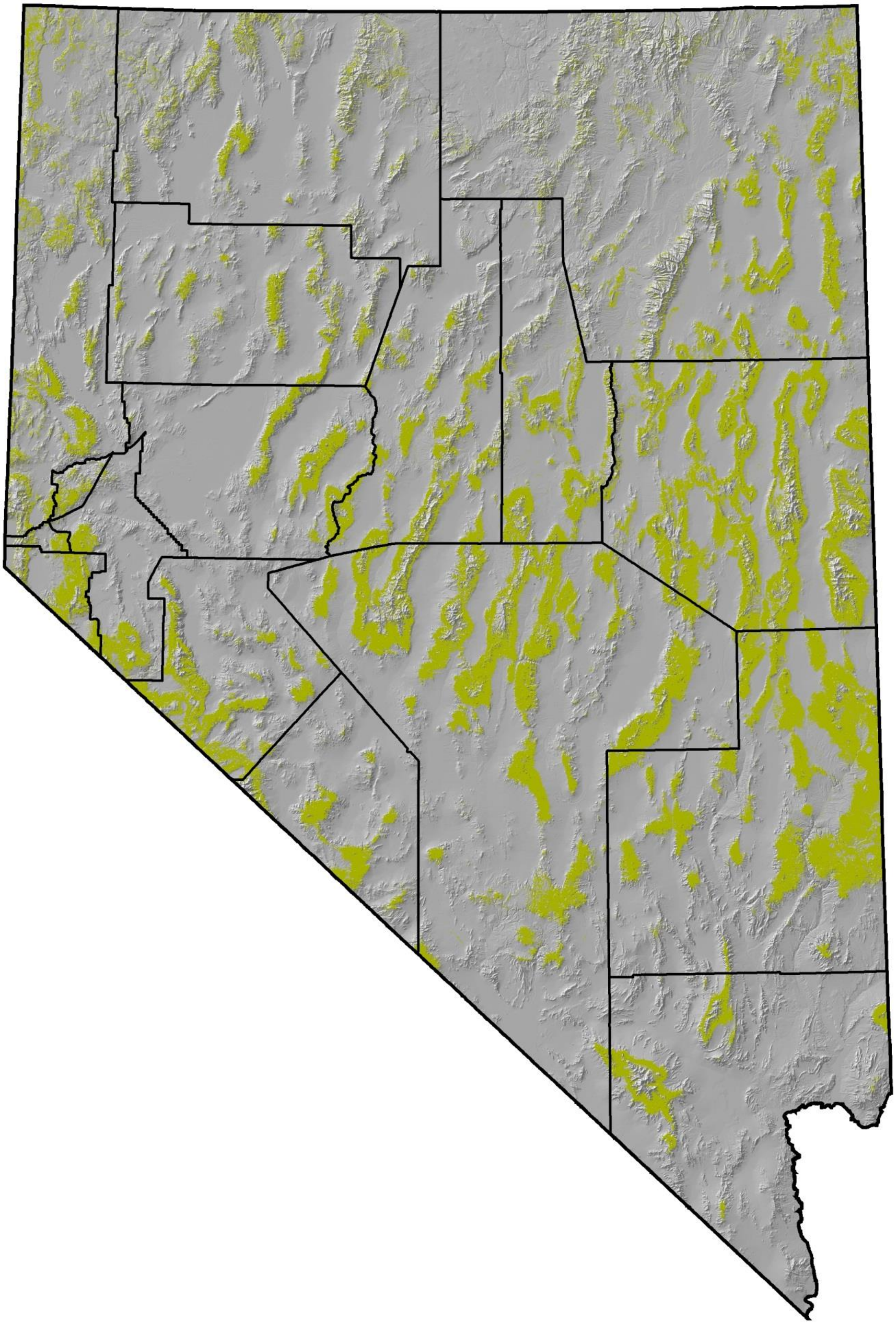


Figure 9. Distribution of Lower Montane Woodlands & Chaparral Habitat type in Nevada.

KEY HABITAT: LOWER MONTANE WOODLANDS AND CHAPARRAL

Things to Know….

- Lower montane woodlands and chaparral are found 5,000-8,000 feet in elevation and characterized by pinyon pine and juniper species mixed with shrub species, such as mountain mahogany, sagebrush, black sagebrush, and bitterbrush.
- Several priority species, including Pinyon Jay, Ferruginous Hawk, Dusky and Sooty Grouse,and several bat species, utilize various featrues of this habitat type.
- Largest habitat threat is cheatgrass invasion and uncharacteristic crown fires.
- In general, the lower montane habitat ecological departure will improve with climate change however, annual grassland conversion will increase.

Ecoregions

Southwest ReGAP 2005

Great Basin	1,895,051 hectares	4,679,139 acres
Columbia	93,817 hectares	231,647 acres
Mojave	173,980 hectares	429,580 acres
Sierra Nevada	3,859 hectares	9,529 acres
Total	2,166,707 hectares	5,349,895 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Pinyon-Juniper……………………..	S040 Great Basin Pinyon-Juniper Woodland
Mountain Shrub…………………..	S046 Rocky Mountain Gambel Oak-Mixed Montane Shrubland
Curl-leaf Mountain Mahogany..	S050 Intermountain Basins Mountain Mahogany Woodland and Shrubland
Chaparral…………………………….	S053 Great Basin Semi-Desert Chaparral
Juniper Savanna……………………	S075 Intermountain Basins Juniper Savanna

Key Habitat Description

The term "lower montane woodlands" is used to describe an association of pygmy forest types growing on unproductive soils and rock outcrops favoring long fire return intervals and that generally occur on montane slopes found between 5,000 and 8,000 feet elevation, but will reach as far down as 4,000 feet at the edge of the Mojave Desert, and as high as 10,000 feet on the White Mountains (Trimble 1989). These vegetative communities include pure to nearly pure stands of singleleaf pinyon pine and any of four species of junipers – Utah, Western, Rocky Mountain, or California mixed variably with mountain mahogany, big sagebrush, low and black sagebrush, bitterbrush, littleleaf mountain mahogany, cliffrose, manzanita, oaks (southern Nevada only), and several bunchgrass species. Ponderosa pine, white fir, and Jeffrey pine may be present along its upper margins, while sagebrush communities are generally dispersed around the lower montane woodland zone. Pinyon-juniper woodlands include pure to nearly pure stands of singleleaf pinyon pine and any of four species of junipers – Utah, Western, Rocky Mountain, or California. This woodland is sometimes referred to as a pygmy forest for its short stature; even at maturity individual trees rarely exceed six meters in height. Individual trees in these woodlands can reach one to two thousand years of age. Physical features of pinyon-juniper woodlands are highly variable, even within a single mountain range.

Many factors interact in a complex manner to determine the elevation limits of lower montane woodland, which vary throughout Nevada, including total annual precipitation, seasonal precipitation pattern, and thermal minima and maxima during the growing season and winter. For instance, juniper typically occurs in pure stands at the lower elevations (Tausch and West 1988), mainly because it is adapted to survive on drier sites (Trimble 1989). The communities associated with this habitat are highly variable and complex. Variability is controlled by current environmental conditions, such as geology and soil type (West et. al. 1998), climatic changes, and modification of landforms by paleo-climatic events (Tausch 1998).

Curl-leaf mountain mahogany generally occurs in scattered pockets to large patches on mountain slopes between 5,000 and 10,000 feet throughout the Great Basin and is most common in central, eastern, and northern Nevada. Curl-leaf mountain mahogany is a drought resistant evergreen tree that can attain a height of about 10 meters (Lanner, 1984). Some old growth stands have been documented at over 700 years old (Schultz 1987), with individual trees estimated as old as 1,350 years (it is not possible to age curl-leaf mountain mahogany from tree rings beyond a certain age). The BpS occurs on sites characterized by steep, rocky, dry slopes generally above the 30 cm precipitation zone. Depending on soil and geology, curl-leaf mountain mahogany has the potential to grow either into nearly impenetrable thickets with a closed canopy or savannas dominated by large trees. The less common species, littleleaf mountain mahogany, is included in this BpS and is restricted to calcareous rock benches, bedrock crevices, and talus in eastern Nevada and other areas with carbonate geology. Other plant species typically found in mountain mahogany stands include big sagebrush, bitterbrush, ceanothus, Indian paintbrush, arrowleaf balsamroot, lupines, and a high diversity of bunchgrass species. Associated tree species include white fir, limber pine, bristlecone pine, subalpine fir, and dwarf juniper.

The mountain shrub BpS is often considered a variation of mountain big sagebrush communities dependent of snow pockets persisting into the early summer, but the BpS is also found on the toe of montane slopes and rock talus where subsurface flow might be critical. Indicator species are snowberry, serviceberry, Stansbury cliffrose, and antelope or desert bitterbrush (when dominant). Serviceberry and Stansbury cliffrose can easily reach 6 feet in height. Under fire suppressed conditions persisting for at least 50 years, pinyon and juniper can become important.

Chaparral habitat is generally characterized by hot dry summers and cool moist winters and dominated by a dense growth of mostly small-leaved evergreen shrubs. In Nevada, Great Basin semi-desert chaparral is found on side slopes transitioning from low-elevation desert landscapes into pinyon-juniper woodlands. Shrub cover typically alternates between thick patches and fairly open-canopy shrublands with spaces between shrubs either bare or supporting patchy grasses and forbs. Characteristic species may include manzanita, ceanothus, mountain mahogany (though usually absent), California buckwheat, ashy silktassel, shrub live oak, and oak leaf sumac. Typical fire regime in these systems varies with the amount of organic accumulation (NatureServe, 2005), but is invariably stand replacing with a mean fire return interval <100 years.

Mogollon chaparral occurs more extensively across central Arizona and western New Mexico, but also extends into southern Nevada. It often dominates along the mid-elevation transition (1,000-2,200 meters) between Mojave Desert scrub and montane types. It occurs on foothills, mountain slopes, and canyons in drier habitats below the ponderosa pine woodlands. Stands are often associated with dry, coarse-textured substrates such as limestone, basalt, or alluvium. The moderate-to-dense shrub canopy includes species such as turbinella oak, mountain mahogany, crucifixion thorn, ceanothus, dwarf desert olive, silktassel, cliffrose, sumac, and manzanita at higher elevations. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are the result of recent fires and, with fire suppression, will be encroached by pinyon and juniper that will persist until the next stand replacing fire (NatureServe, 2005), usually recurring every 50-75 years.).

Value to Wildlife

Juniper savannah on badland soils and at the upper edge of drainages, and pinyon-juniper woodlands on unproductive soils provide a variety of sheltering functions for wildlife that range from hiding cover to cavities and nest sites for birds, bats, and small mammals. As an evergreen cover, the forests probably provide important thermal protection for wildlife during winter, and certainly provide shelter from summer's intense sun. The Ferruginous Hawk exploits pinyon-juniper by relying on older trees of sufficient size and structure to support their large nest platforms, but these trees must be located at the lower edge of the forest or on upper slopes of drainages with thin soils where they provide a long view of surrounding, open sagebrush expanses where their prey occur. For birds and bats in particular, the pinyon-juniper woodland provides structure for nesting and roosting, and locations for foraging, that would otherwise be missing from the mid-elevation cold desert were it dominated by shrubs.

One of the critical products of the pinyon-juniper woodland is the pinyon nut crop, which is exploited both by humans (including a Native American tradition that dates back for millennia) and wildlife. Species such as the Pinyon Jay and small mammals are strongly tied to this resource. Though not so closely tied to a single species, the juniper berry crop is also an important food resource for birds and small mammals.

Mountain shrubs such as snowberry, serviceberry, Stansbury cliffrose, and bitterbrush, provide critical browse for deer; their fruits are important for small mammals, birds, and beaver, and marmot eat their bark (Stubbendieck et al., 1992). Cliffrose is a mule deer staple, especially in winter months. This densely vegetated type also provides important cover for wildlife species from birds to mammals to reptiles.

Curl-leaf mountain mahogany provides similar values–cover, nest sites, and foraging opportunities–but in a subtly different fashion. The overstory created by mountain mahogany tends to be sparser than the thick canopy that can form in pinyon-juniper, and as such more diffuse light tends to reach the ground. In young-to-middle aged thickets or savannas of old trees of mountain mahogany the understory often supports a large variety of forbs, grasses, and shrubs, all of which offer foraging opportunities for birds, small mammals, and reptiles. Various mountain shrubs under the canopy of curl-leaf mountain mahogany provide valuable forage to wildlife (Stubbendieck et al., 1992).

Lower montane chaparral is limited in extent in Nevada. Where chaparral does occur, it offers thickets of vegetation that provide excellent cover for birds and small mammals. Turbinella oak leaves provide browse for mule deer, and their mast crop (acorns) are sought by small mammals and many species of birds. In addition, birds such as hummingbirds and flycatchers forage in this type which they access from nest sites in adjacent forests. Manzanita, ceanothus, oaks, and many of the other species comprising chaparral provide seeds and fruits for a wide variety of wildlife.

Key Elements of Lower Montane Woodlands Habitat Important to Wildlife

WOODLAND NON-SPECIFIC

MATURE STAND/SNAGS/CAVITY – nesting/roosting structure, protection from predators, dying trees provide insect prey base

long-eared myotis
Allen's big-eared bat
western small-footed myotis
fringed myotis
little brown bat

ROCKS/MINES – nesting, roosting, protection from predators

Gray-crowned Rosy-Finch
Black Rosy-Finch
Sonoran Mountain kingsnake
Great Basin collared lizard
Panamint alligator lizard

AERIAL FEEDERS/MIGRANTS – species foraging in this habitat (e.g., aerial insectivores, bird species during migration)

Townsend's big-eared bat
spotted bat

TERRESTRIAL ARTHROPOD FEEDERS

Inyo shrew
Merriam's shrew
greater short-horned lizard
pygmy short-horned lizard

SHRUBS – shrub feeders, protection from predators, thermal cover, nesting structure

Mountain Quail
Dusky Grouse
Sooty Grouse
Loggerhead Shrike
Black-chinned Sparrow
bighorn sheep
mule deer
shadow (Allen's) chipmunk
Palmer's chipmunk
Sierra Nevada snowshoe hare
bighorn sheep
mule deer
Palmer's chipmunk

RIPARIAN ECOTONE – foraging, nesting

Virginia's Warbler

DUFF/LITTER

Western red-tailed skink
Western threadsnake

PINYON-JUNIPER

LARGE OLD TREES – nesting structure

Ferruginous Hawk

CONE-BEARING STANDS – foraging

Pinyon Jay
Cassin's Finch

Existing Environment

Land Uses

- Livestock grazing
- Motorized recreation
- Non-motorized recreation
- Recreation development
- Wind energy development
- Wood products extraction
- Urban/suburban development
- Military mission
- Species harvest

Habitat Conditions

Pinyon-juniper woodlands, generally being found on steep and unproductive soils, are usually in good condition because access is difficult and water is limited for livestock. Many woodlands in proximity of mines (<5 miles) may have been thinned or cutover during the historic mining era, but younger trees are found today growing among the remnant old trees. The greatest threats to pinyon-juniper woodlands are invasion by non-native cheatgrass and conversion to non-native annual grassland after fire, uncharacteristic fires either fueled by cheatgrass ignition or originating from tree-encroached shrublands surrounding woodlands, and infilling of young trees between older trees (stand densification; Weisberg et al., 2007).

Curl-leaf mountain mahogany stands in Nevada are stable in distribution, but many are not successfully recruiting and exist in advanced stages of maturity, often with live crowns high out of reach of browsing ungulates. These old, non-regenerating stands are at significant risk to loss by fire and once burned, may be hard to recover because mountain mahogany does not generally sprout after burning and regeneration of burned stands from seed appears to be quite low (Forest Service, 2005). Although curl-leaf mountain mahogany produces abundant seed, seedlings suffer from very high herbivory from mule deer and small mammals (seedlings are very high in palatable nitrogen) and require mineral soil as they do not tolerate competition from other plant species, including cheatgrass.

Fire suppression working in concert with overutilization by ungulates has likely contributed to the progression of mountain shrub stands towards dominance by pinyon and juniper in many areas of its occurrence in Nevada.

Tree encroachment will further accelerate the decline of the shrub community because of increased shading and competition for soil moisture.

Problems Facing the Species and Habitats

Problems associated with the ecological systems comprising this key habitat type include invasion by cheatgrass, uncharacteristic crown fires in woodlands originating from tree-encroached shrublands, tree-encroachment of mountain shrub communities, conversion to non-native annual grasslands, and stand densification. Rarity of successful recruitment in curl-leaf mountain mahogany patches that have burned has been identified as a threat to the maintenance of the BpS. In some places where recreational activities are superimposed over wildlife habitat, disturbance to wildlife (movements/displacement, behavior, reproductive success) may result, and locally illegal activities such as poaching, and illegal collection or killing may constitute a problem for wildlife populations.

Predicted Effects of Climate Change

Pinyon-Juniper

Pinyon-juniper occurred in all 13 phytographic regions analyzed by TNC, with current conditions usually over 90% within characteristic classes for all regions. Currently, pinyon-juniper habitats are departed from reference conditions by having “excessive” percentages in the mid2-open class (11-30% pinyon-juniper cover, trees 30-99 years old), and “deficiencies” of percentages in the late-open class (31-50% pinyon-juniper cover, trees over 99 years old). Fifty years of climate change was predicted to actually facilitate the transition of significant percentages from “mid2-open” to late-open such that the ecological departure calculations *improved* for the majority of regions. Transitions to uncharacteristic conditions from current conditions varied greatly among regions, especially the Tree-Annual-Grass class. Some regions showed little change in annual grass invasion (Elko 6%, Eastern Sierra 3%, Toiyabe 4%, Tonopah 3%, and Walker 4%), whereas others registered order of magnitude increases leading to significance percentages of uncharacteristic classes after 50 years as high as 50% (Eureka 10%, Humboldt 18%, Lahontan 15%, Owyhee 50%, and Mojave 50%) for most regions.

Juniper Savanna

This community occurred in only three of the 13 phytographic regions, totaling approximately 2,500 acres. Juniper savanna is often synonymous with badland soils. Its primary value to wildlife is probably providing nesting sites for Ferruginous Hawks, which prefer to build their huge nests in large, often isolated juniper trees along the juniper-sage interface. Ecological condition varied greatly between the three regions. Over 90% of the type occurred in characteristic classes in the Calcareous and Mojave regions, but departure from reference was represented by excessive percentages in the late-open class in the Calcareous region and in the late-closed class in the Mojave. The type was 48% invaded by annual grasses in the Elko region. Fifty years of climate change was predicted to actually move ecological condition closer to reference conditions, and no loss of type to conversion was predicted.

Mountain Mahogany

Curl-leaf mountain mahogany occurred in 12 of the 13 phytographic regions. With the notable exception of Elko, this BpS is currently over 90% in characteristic classes. The Elko region is currently 38% invaded by annual grasses. Distribution among characteristic classes varies greatly from region to region, but nearly all deviate from reference conditions in having a predominance of percentages in the characteristic classes younger than late-closed. Fifty years of climate change was predicted to inch class composition slowly toward reference conditions and in most regions ecological condition was slightly improved with a very small (one to five percent) increase in annual grass invasion. One notable exception was the Mojave region, where annual grass invasion was predicted to hit 28% after 50 years of climate change.

Mountain Shrub

The mountain shrub BpS was encountered in six of 13 phytographic regions. Percentages in uncharacteristic classes varied considerably between regions, from five percent in the Black Rock region to a dramatic 85% (tree-encroached) in the Mojave. Among characteristic classes, most regions deviated from reference conditions with deficiencies in the late-open class. Wildlife habitat suitability was deemed to be significantly compromised in the "early shrub" (rabbitbrush) and "tree-encroached" classes, and increases in these classes after 50 years of climate change were predicted to occur between zero percent (Owyhee) and 19% (Clover). The Mojave mountain shrub BpS was expected to increase from 85% to 93% tree-encroached after 50 years of climate change. A three percent loss to conversion to sagebrush or chaparral (in southern Nevada) statewide was predicted for this BpS after the 50-year climate change evaluation period.

Chaparral

The chaparral BpS was encountered in eight of 13 regions. The Eastern Sierra and Lahontan regions were 13-14% invaded by annual grasses but the other six regions were two percent or less invaded. Regions along the eastern border (Calcareous and Clover) were 10-15% heavy in the late-closed class with a deficiency in the recruiting "early" class. The other regions were all 40-75% too heavy in the "early" class with deficiencies in the mature stage. Over 50 years of climate change, the BpS was predicted to experience 20-30% annual grass invasion in all regions except the Mojave, where ecological departure was predicted to improve and acreage was actually predicted to increase. The Toiyabe region was predicted to lose its 80 acres in 50 years with or without climate change. Since there seems yet to be observed an annual-grass class generally void of shrub cover, we are assuming that chaparral remains functional as wildlife habitat with annual grass invasion, and the type was actually predicted to increase by one percent in 50 years with climate change. Chaparral was modeled as a recipient BpS of many climate-change conversions occurring in more mesic shrubland, woodland, and forest BpS's.

Possible Wildlife Responses to Climate Change

Pinyon-Juniper

Of all transition classes of pinyon-juniper described by LANDFIRE, the only ones deemed likely to be vacated significantly by pinyon-juniper-dependent animal species were the "early" characteristic class and the "annual grass" uncharacteristic class. TNC's habitat analysis indicated that very little acreage currently occurs in either class and that very little was likely to transition to those classes in 50 years.

Pinyon Jays in a radio telemetry study (GBBO, 2010) exhibited a very complex utilization pattern of pinyon-juniper and surrounding habitats, roosting and nesting in denser, older stands but foraging much of their time in the thinly-treed ecotones and expansion margins between pinyon-juniper and sagebrush or other upland shrub types. The Nevada Bird Count climate change analysis (GBBO, 2011) indicated that as high as 19% of the state's current population of Pinyon Jays might be displaced as a result of 50 years of modeled climate change. It is currently not possible to predict the ultimate fate of these displaced birds, but it appears there are four possible outcomes:

1) Adapt to site changes in their current home ranges
2) Increase densities in unaffected suitable habitat
3) Leave the state
4) Reduce population size through decreased productivity/survival

Monitoring birds statewide will give us the ability to actually observe what outcomes were most prevalent in reality, which will in turn allow us to make more accurate predictions for the next projection interval.

Cassin's Finch was expected to benefit from the transition of early and mid-classes of pinyon-juniper to late-closed. Olive-sided Flycatchers occurred in pinyon-juniper in very sparse densities and were expected to benefit from the same transition. Scott's Oriole, primarily associated with Joshua tree in Nevada but reported to also occur in pinyon-juniper, was expected to be displaced by the transition of early-mid classes to late, suggesting that as pinyon-juniper stands closed the occurrence of Joshua tree could be expected to decrease. Ferruginous Hawk nesting and bat roosting were not expected to be negatively impacted by the transition to older stands.

Juniper Savanna

The juniper savanna BpS was not expected to lose any of its value as Ferruginous Hawk nesting habitat. Other values to wildlife not so well understood were also not expected to be negatively impacted since the climate change predictions are expected to move this BpS closer to reference condition.

Mountain Mahogany

All characteristic succession classes were included in a single "mountain mahogany" group in the Nevada Bird Count climate change analysis and no NBC points occurred in the two uncharacteristic classes, so change and effect could only be expressed as functions of habitat type conversion and not as functions of transitions within the BpS. Virginia's Warblers were recorded in their second highest densities in the state in the mountain mahogany BpS (0.55 birds/40 ha). Four percent of the current population was predicted to be displaced by loss of mountain mahogany to conversion. Of the transition classes within the mountain mahogany BpS, only the "annual grass" class was expected to present unsuitable habitat for most mountain mahogany-associated species. The increase in the "annual grass" class predicted with climate change was less than five percent in all regions except Mojave, where it was predicted to increase 25%. No mammals or reptiles of conservation priority were considered to be especially dependent on mountain mahogany habitats, although mule deer and desert bighorn sheep might be expected to respond negatively to the 25% annual grass class increase in the Mojave region more than any other species.

Mountain Shrub

The percent loss to conversion of the mountain shrub BpS varies considerably among regions, with the eastern border regions (Elko, Calcareous, and Clover) especially hard-hit (18 to 28% loss). The Mojave region registered the second highest total acreage lost, but because the Mojave region was by far the region with the greatest total acreage of the type, the loss amounted to only five percent of the current mountain shrub total. Twenty percent losses in the eastern regions would be expected to negatively impact mule deer production and fawn survival as mountain shrub communities in those regions are so predominantly populated by summering mule deer does. In addition to this loss, tree-encroachment by pinyon and juniper of mountain shrub communities results in suppression of browse productivity that comprises a critical part of deer summer range (NDOW, 2011).

The importance of the habitat dependency is so great that mule deer population numbers in those regions might be expected to reach as high as 20% – a “one-to-one” ratio indicating that mule deer populations are generally considered to be at carrying capacity in current conditions (NDOW, 2011). The Nevada Bird Count climate change analysis suggested that the 13% loss of mountain shrub acreage to conversion statewide would contribute toward overall displacement of Black-chinned Sparrows, Virginia’s Warblers, Pinyon Jays, and Scott’s Orioles throughout their ranges in Nevada.

Chaparral

No detrimental trends attributable to climate change were projected for the chaparral BpS; therefore, it is expected that wildlife populations and distributions would not be significantly impacted in this type. Two species particularly associated with chaparral in the Sierra Nevada and Eastern Sierra are the Mountain Quail and Sierra Nevada snowshoe hare. In addition, because the shadow (Allen’s) chipmunk is known as a reluctant tree climber, cover provided by chaparral understories on the forest floor may have elevated value to this species for survival.

Taking Prescriptive Action

Corrective management prescriptions were developed only for mountain shrub communities in the Elko, Calcareous, and Mojave regions. According to agency experts, pinyon-juniper and curl-leaf mountain mahogany woodlands are frequently too steep and restoration success too low for practical management actions. It is expected that extrapolation of results could be applied to the Clover region from either the Calcareous or Mojave results. Each region required a different prescription because type conditions were different between them (aged stands – Calcareous and Elko; tree encroachment – Mojave; non-native annual grass). See Appendix C for more information on prescriptive actions.

Priority Research Needs

- Further investigations of Pinyon Jay habitat use during and after high cone crop years to test new findings regarding preferences for young classes and invasion zones.
- Identify and quantify the processes influencing pinyon nut production, including the predicted or measured effects of climate change
- Determine wildlife/habitats relationships for priority mammals and reptiles in mountain shrub
- Develop knowledge of mountain mahogany ecology and regeneration
- Delineate and quantify value of pinyon-juniper woodlands to bat roosting, including identification of key species, different roosting strategies, and landscape management implications

Priority Monitoring Needs

- Mule deer in mountain shrub BpS in three key eastern regions
- Pinyon Jays in pinyon-juniper and p-j-invaded sagebrush BpS’s

Conservation Strategy

Goal: Thriving self-sustaining wildlife populations in healthy plant communities on stable soils devoid of destructive erosion, in appropriate potential natural vegetation; maintenance of mixed montane shrubland and grass-forb understory components through natural fire return intervals or mimicked by non-natural disturbance; maintenance of a full range of multi-age stands for all lower montane woodland types, including mature stands of pinyon with snags; naturally regenerating mountain mahogany stands protected from fire.

Objective: Apply restoration treatment of mountain shrub communities in the Elko, Calcareous, and Clover regions to restore ecological health and mitigate the loss to conversion through 2022.

"ecological health" – not more than 20% in uncharacteristic classes; characteristic classes redistributed to closer approximate reference conditions.
Action: Map mountain shrub stands throughout the state at a scale finer than SWReGAP.

Action: Determine condition and trend of mountain brush stands; prioritize stands for active regeneration management; identify soil sites within pinyon-juniper woodlands that might convert to mountain brush with pinyon-juniper removal; augment natural mountain brush regeneration with planted stocks and/or reseeding.

Action: In coordination with federal agencies, protect regenerating mountain brush sites from livestock grazing for an appropriate period of time to ensure stand viability.

Objective: Maintain mule deer populations at stable or increasing trend statewide with particular focus on avoiding declines in the Elko, Calcareous, and Clover regions through 2022.

Action: Actively manage and restore mountain brush communities as per actions above.

Action: Continue to work with conservation organizations, sportsmen's groups, private industry, landowners and federal agencies to conserve existing mountain brush communities with emphasis on land use planning, private lands assistance, and active restoration.

Objective: Increase Mountain Quail distribution 10% by 2022.

"distribution" – distinct geographic locations where Mountain Quail occur.

Action: Maintain an opportunistic trap and transplant program for Mountain Quail both inside and outside the state with the necessary public land use planning clearances approved for action when opportunity exists.

Action: Supplement Mountain Quail introductions and augmentations with well-scouted and designed guzzlers where water availability might otherwise be restrictive.

Objective: Maintain Sooty Grouse and Dusky Grouse at current distribution through 2022.

"distribution" – distinct geographic locations where Sooty and Dusky Grouse occur.

Action: Conserve mountain brush and chaparral communities in landscape context with aspen, riparian and conifer winter habitats to ascertain provision of resources for all life history needs of Dusky and Sooty Grouse.

Action: Continue to cooperate in a species delineation/genetics study that would verify Sooty and Dusky Grouse ranges across the state.

Objective: Maintain pinyon-juniper at current distribution and in condition concomitant with climate change on soil sites historically characterized by pinyon-juniper communities through 2022.

Action: Manage grazing regimes (timing, intensity) in pinyon-juniper and mountain mahogany to permit natural reseeding of native grasses and forbs.

Action: Manage for self-replacing, multi-aged pinyon-juniper stands in a heterogeneous mosaic across the landscape.

Action: Identify key pinyon-juniper habitat characteristics for healthy wildlife populations.

Action: Develop a model using a statewide pinyon-juniper habitat condition map so that treatments can be applied to landscapes to manage for habitat complexity.

Action: Manage treatments to retain snags and mature trees with cavities and complex structure to support nest and roost sites.

Objective: Maintain a population estimate of 428,000 Pinyon Jays statewide through 2022.

"population estimate of 428,000" – as reported in the 2011 Nevada Bird Conservation Plan

Action: Develop predictive models and inventory potential breeding habitat for Pinyon Jay to inform an integrated conservation strategy that maintains breeding flocks in appropriate sites throughout their range.

Objective: Retain vigorous, productive stands of mountain mahogany on appropriate sites through 2022.

Action: Identify healthy mountain mahogany stands that bear significant seed crops under required climatic conditions.

Action: Prioritize healthy mountain mahogany stands for protection during wildfire events.

Action: Manage landscapes adjacent to healthy mountain mahogany stands to minimize the threat of wildfire spreading to reproductive stands.

Objective: Maintain populations of other birds of conservation priority at stable or increasing trend and distribution concomitant with climate change habitat shifts through 2022.

("stable or increasing trend" – as measured by Nevada Bird Count, USGS Breeding Bird Survey, or supplemental special species monitoring protocol)

Action: Supplement Nevada Bird Count and USGS Breeding Bird Survey coverage with point count surveys targeted for mountain brush and mountain mahogany communities.

Action: Monitor priority bird responses to active mountain brush habitat restoration.

Action: Develop a reportage protocol for recording Rosy-Finch winter roost sites and accumulate and maintain an atlas of documented winter roost locations.

Action: Develop a statistically robust Ferruginous Hawk nesting activity monitoring program that will lead to a statewide breeding range population estimate and specific understanding of nest activity shifts within statewide range influenced by geographically fluctuating prey populations.

Objective: Maintain priority mammals and reptiles at detectable levels in suitable habitat through 2022.

"detectable levels" – as determined by regularly scheduled surveillance monitoring (live trapping, ANABAT, ocular or pit trap survey) conducted at intervals not to exceed five years.

Action: Inventory pinyon-juniper habitat for bat roosting activity; develop optimal habitat models and perform risk assessment for appropriate species.

Action: Expand Sonoran mountain kingsnake discovery surveys into select mountain ranges in the Calcareous and Clover regions.

Action: Verify the existence (or absence) of Panamint alligator lizard in Nevada via discovery surveys in mountain ranges adjacent to known occupied range along the California border.

Action: Delineate occupied range of Sierra Nevada snowshoe hare in Nevada and determine the degree of population and habitat connectivity with California populations. Identify specific existing linkage corridors and/or linkage corridor restoration needs leading to specific plans to actively restore corridors where needed.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	79.2
U.S. Forest Service	13.5

Private	6.2
Other	1.1

Existing partnerships, plans, and programs

Federal & State Agencies
- Nevada Department of Wildlife
- Bureau of Land Management
- U.S. Forest Service
- National Park Service (Great Basin National Park)
- Nevada Division of Forestry

Conservation Organizations
- National Audubon Society/Lahontan Audubon Society
- Eastern Nevada Landscape Coalition
- The Nature Conservancy
- Sierra Club
- Nevada Wilderness Coalition

Bird Initiatives
- Nevada Partners In Flight &Nevada Bird Conservation Plan
- Partners in Flight North American Land Bird Conservation Plan

Other Key Partners
- Counties
- Intermountain West Joint Venture
- University of Nevada (UNR, UNLV)

Focal Areas

Buffalo Hills
Butte Valley
Carson Range
Cave Valley
Cherry Creek Range
Clan Alpine Mountains
Crooks Lake and plateau
Goshute Mountains
Granite Range
Hays Canyon Range
Madelin Mesa
Pancake Range
Pequop Mountains
Roberts Creek Mountains
Ruby Mountains
Santa Rosa Range
Sheldon NWR
Silver Peak Range
Simpson Park Range
Snake Range
Snake Valley
Spring Mountains
Spring Valley
Spruce Mountain
Steptoe Valley
Toiyabe Range
Toquima Range
Wassuk Range
White River Valley
White Rock Mountains

Intermountain Coniferous Forest & Woodlands

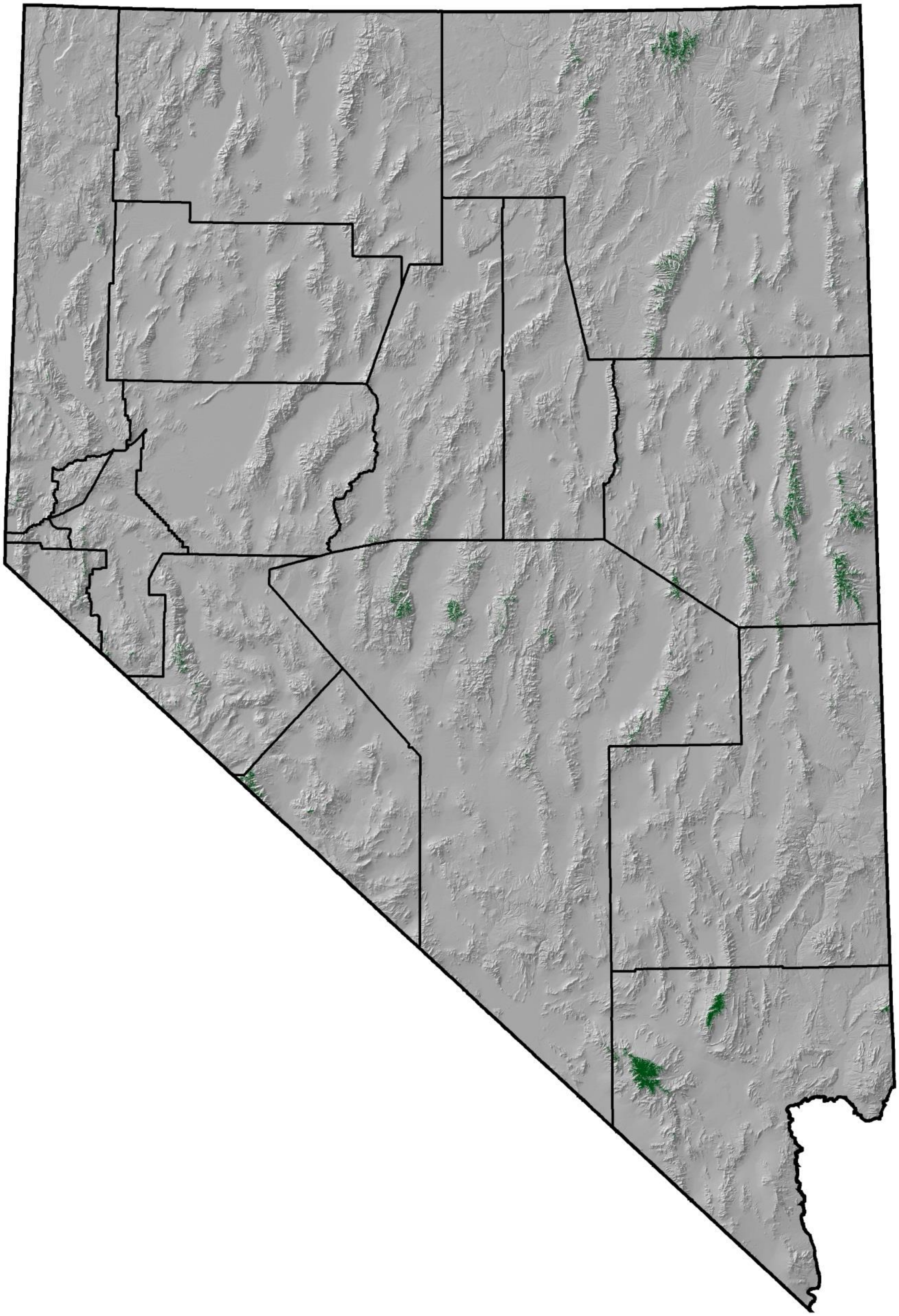


Figure 10. Distribution of Intermountain Coniferous Forests and Woodlands in Nevada.

KEY HABITAT: INTERMOUNTAIN CONIFEROUS FORESTS AND WOODLANDS

Things to Know….

- Intermountain conifer forests and woodlands in Nevada are comprised of diverse forested communities that occur in the mountains above the lower montane woodland and shrubland habitats.
- Wildlife depend on stand structure and canopy cover to provide the proper foraging and nesting provided by conifer forests and woodlands. Key priority species include Olive-sided Flycatcher and Flammulated Owl.
- Habitat threats include loss of nest cavities and snags due to removal of wood products and loss of understory vegetation due to extensive grazing or recreational activities.
- Climate change effects within this habitat type are very diverse and complex across regions.
- Management strategy development was limited to mixed conifer and ponderosa pine in the Mojave region. In the Great Basin, Intermountain coniferous forests rarely receive management attention because they usually occupy very steep rocky slopes.

Ecoregions

Southwest ReGAP 2005

Great Basin	100,466 hectares	248,063 acres
Columbia Plateau	34,118 hectares	84,242 acres
Mojave	25,259 hectares	62,368 acres
Total	159,843 hectares	394,673 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Limber-Bristlecone Pine Woodland…….	S025 Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland S026 Intermountain Basin Subalpine Limber-Bristlecone Pine Woodland
Mixed Conifer………………………………..	S032 Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland S034 Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
Ponderosa Pine………………………………..	S036 Rocky Mountain Ponderosa Pine Woodland
Spruce-Fir………………………………………..	S028 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland S030 Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland

Key Habitat Description

Intermountain conifer forests and woodlands in Nevada are comprised of diverse forested communities that occur in the mountains above the lower montane woodland and shrubland habitats. Montane conifer forests are dominated by a variety of conifers including white fir, Jeffrey pine, Douglas-fir (eastern Nevada only), lodgepole pine (western Nevada only), and ponderosa pine. The deciduous quaking aspen is often part of these forest types but only as isolated trees and small clumps. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the conifer community. White fir dominates at higher, colder locations while Douglas-fir co-dominates intermediate zones in a few eastern mountain ranges (NatureServe, 2004). Understory shrub components include greenleaf manzanita, snowberry, curl-leaf mountain mahogany, creeping barberry, mountain big sagebrush, and common juniper. The herbaceous grass and forb cover includes bluebunch wheatgrass, common yarrow, Engelmann aster, duncecap larkspur, sticky geranium, silvery lupine, western sweet cicely, western bracken fern, western coneflower, Fendler meadowrue, western valerian, northern mule's ear, and many others. Montane forest and woodland habitats in Nevada typically occur at elevations between 1,200 and 3,300 meters (3,937 and 10,827 feet).

Subalpine forests and woodlands occur to treeline at approximately 3,300 meters (11,000 feet) above which they may persist only as clumps in which the trees typically assume stunted growth forms highly influence by wind and the harsh conditions of high-elevation sites. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. Englemann spruce (eastern Nevada only) and subalpine fir (in northeastern Nevada only) forests are found at cold sites where precipitation is predominantly in the form of snow, sometimes persisting until late summer, and appear to depend on monsoonal precipitation as these species only exist in ranges at the edge of the monsoonal influence. Higher elevation limber-bristlecone pine woodlands are found well into the subalpine – alpine transition on wind-blasted, mostly west-facing slopes and exposed ridges. Sites are typically harsh, exposed to desiccating winds with rocky substrates and a short growing season that limits plant growth (NatureServe, 2004). A mesic, closed-canopy form of limber-bristlecone pine is extensive on the Snake Range. In Nevada, subalpine forest and woodland habitats are composed of stands dominated by limber pine, intermountain bristlecone pine, Engelmann spruce, subalpine fir (northeastern Nevada only), or whitebark pine (Sierra Nevada only), and quaking aspen is an occasional tree species. The understory shrub component includes common juniper, mountain gooseberry, and mountain mahogany. Dominant herbaceous layer species include Ross sedge and Fendler meadowrue (Nachlinger et al., 2001).

Value to Wildlife

Wildlife depend on a variety of features for foraging and nesting provided by conifer forests and woodlands, including mesic microsites, mid-story structure, and mature canopy. In addition, some wildlife in conifer forests and woodlands primarily make use of the conifer-riparian ecotone because of the diversity of plant growth and edge conditions in these areas (Hill, 1995).

Mature or old growth conifer forests are also valuable to wildlife because they provide an abundance of insect infected snags or dying trees. Trees with heart rot provide the essential substrate for cavity excavation which is important for wildlife nesting or denning, and dying trees provide an insect prey base for foraging. Some species are tied to temporal disturbances in conifer habitats (e.g., Lewis's Woodpecker), because they require the resulting insect outbreaks (Leonard, 2001).

Although higher elevation conifer woodlands do not provide large patches of "forest" for wildlife, these communities are still important. Wildlife species feed on limber and bristlecone pine seeds, and the trees provide structure in an otherwise sparsely vegetated environment. Conversely, limber pine communities benefit from wildlife since its natural regeneration appears to be closely associated with caching of the large wingless seeds, primarily by Clark's nutcracker (NatureServe, 2004).

Key Elements of Intermountain Coniferous Forests and Woodlands Habitat Important to Wildlife

MATURE OVERSTORY/DOWN WOODY MATERIAL – nesting structure, roosting, protection from predators

Northern Goshawk
Flammulated Owl
Palmer's chipmunk

MID-STORY STRUCTURE – nesting structure, foraging

hoary bat
Humboldt yellow-pine chipmunk

SHRUB AND HERBACEOUS COVER – protection from predators, foraging, thermal cover

Dusky Grouse
Mountain Quail
Humboldt yellow-pine chipmunk
Inyo shrew
Montane shrew
mule deer

SNAGS/CAVITIES – nesting, roosting (under exfoliating bark or in cavities), foraging (insect prey base in dying trees)

Lewis's Woodpecker
Olive-sided Flycatcher
Flammulated Owl
Allen's big-eared bat
long-eared myotis
silver-haired bat

RIPARIAN ECOTONE – foraging (diversity of plant growth), protection from predators and nesting (edge conditions resulting in dense cover)

Cassin's Finch
Sonoran Mountain Kingsnake
Western red-tailed skink

MESIC MICROSITES – foraging

montane shrew
northern rubber boa

Existing Environment

Land Uses

- Livestock grazing
- Wood products extraction – fuel wood
- Motorized and non-motorized recreation
- Recreation development
- Urban/suburban development
- Species harvest

Habitat Conditions

Present-day ponderosa pine forests differ greatly from pre-settlement forests because of logging, fuel wood harvest, fire suppression, improper grazing, and urban development. Size-class distributions are now skewed to smaller trees, with a more closed canopy, higher levels of disease, depleted understories, and high susceptibility to crown fires. In some ranges such as the Snake Range, historical records indicate large areas of ponderosa pine were logged and have not returned to ponderosa pine; today, pinyon-juniper woodlands, mountain mahogany woodlands, and white fir/Douglas-fir stands permanently occupy these sites. Previously, park like forests with clumps of large trees and grassy openings were maintained by low-intensity ground fires every one to 12 years, limiting dense growth of young pines. It is now likely that wildlife species that rely on large trees are less common in ponderosa-pine forests than they were historically (Stacier and Guzy, 2002). With fire suppression, white fir has vigorously colonized many sites formerly occupied by open ponderosa pine woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests, and the potential for high-intensity crown fires on drier sites now codominated by ponderosa pine and white fir has increased. In general, fire suppression has led to the encroachment of more shade-tolerant, less fire-tolerant species into conifer communities. There has also been a corresponding increase in landscape homogeneity and connectivity resulting in increased potential of lethality and size of fires (NatureServe, 2004). Limber–bristlecone pine woodlands are usually characterized by sparse shrubs, forbs, grasses, and litter with widely spaced trees. Fire does not carry easily in these habitats so they are rarely destroyed from this disturbance (NatureServe, 2004). Fire carries, however, in the mesic, closed-canopy limber-bristlecone pine forest of the Snake Range; indeed, burned areas are heavily used by bighorn sheep.

Englemann spruce, limber, and bristlecone pine habitats are generally in good condition across Nevada, although disease is increasing in the limber pine communities of the Ruby Mountains. In some cases, bristlecone pine has been documented moving down into aspen stands, a phenomenon attributable to fire suppression. Intermountain conifer and woodland habitats in Nevada tend to be in fair and poor condition, primarily as a result of fire suppression, and include mixed aspen-conifer, mixed conifer, white fir, ponderosa pine, and subalpine fir communities.

Problems Facing the Species and Habitats

Natural processes that have shaped the development of conifer forests and woodlands in Nevada include fire, insects, and storms. Natural processes in conifer forests and woodlands have been inhibited by modern forestry practices, including fire suppression, salvage logging (cutting of burned trees), suppression logging (cutting of insect infested trees), and alteration of natural fire intensity. A long history of fire suppression has facilitated blister rust and insect outbreaks in subalpine fir, limber, and whitebark pine communities in Nevada.

Many wildlife species are restricted to forests of commercially valuable trees, and past wood products extraction may have reduced habitat suitability with the removal of large diameter trees. Conifer forests and woodlands in Nevada do not provide many viable commercial opportunities for timber extraction, however, where wood products extraction activities do occur, the most visible impact is loss of nest cavities. At present, the most immediate human threat to species in these habitats may be cutting (authorized and unauthorized) of dead trees for firewood. Extirpation of primary cavity excavators by introduced European Starlings is another potential threat to cavity nesting species. The recruitment of snags (dead trees or branches with good potential for holes) and health of woodpecker populations is essential to conservation of cavity-nesting species (McCallum, 1994).

Other concerns for conifer forests and woodlands include maintenance of a vigorous shrub and herbaceous understory, which may be reduced by ungulate, or livestock grazing, or recreation. Small mammals depend on this structure for food, thermal cover, and protection from predators. A reduction of small mammals in previously suitable habitat will have cascading unfavorable effects to species that rely upon these prey populations. Intermountain conifer forests and woodlands in the Spring Mountains and Sheep Range are influenced by urban development and the concomitant use of federal lands by the growing population of Las Vegas. These areas, particularly the Spring Mountains, are hubs for recreation in southern Nevada. Activities such as winter recreation activities, OHV activities, and dispersed forms of recreation such as hiking and mountain biking, will continue to influence conifer and woodland habitats and their associated species; however, many of the montane and subalpine conifer forests and woodlands of the Mojave Desert are located on steep rugged slopes not easily accessible by any vehicle.

Predicted Climate Change Effects

Twelve of the 13 phytographic regions modeled by TNC were included in this analysis. The lone exclusion was the Eastern Sierra, which will be included in the “Sierra Nevada Coniferous Forests and Woodlands” chapter.

Mixed Conifer

The mixed conifer BpS was recorded in eight of 12 non-Sierra regions, but occurred in substantial acreages (over 400 acres) in only four – Black Rock, Calcareous, Elko, and Mojave. In these regions, mixed conifer was projected to increase with 50 years of climate change (Black Rock 3 percent; Calcareous 4 percent; Elko 17%), and one was projected to decrease (Mojave -4%). Currently, stand conditions were dominated by the mid-closed and mid-open classes in the Black Rock region, 74% mid-closed in the Calcareous regions, 60% late-closed in the Mojave, and 99% tree-annual grass in the Elko region. Modeling fifty years of climate change predicted transitioning from mid-open to mid-closed and late-closed in the Black Rock, a spreading of mid-closed across all characteristic classes in the Calcareous, an increase in characteristic classes in the Elko region (possibly contributed by the overall increase in acreage), and a spreading of late-closed across earlier characteristic classes in the Mojave. Annual grass invasion was considered to be of concern in the Elko region only.

Limber/Bristlecone Pine

The limber/bristlecone pine BpS was recorded in nine of 12 regions. For regions with over 1,000 acres, climate change modeling projected significant increases in acreage in the Calcareous (six percent) and Elko (16%) regions and decreases in the Mojave and Toiyabe regions (two percent each) and the Eureka region (five percent). The Black Rock region, where almost 2,000 acres were recorded, underwent no net change in acreage. No uncharacteristic classes were identified for this BpS. Current seral stage distributions varied considerably among regions. Climate change modeling indicated that regions would progress into three general groupings –

the Black Rock and Elko regions would progress toward a predominance in the mid-open class while the Calcareous, Eureka, and Toiyabe regions would progress toward slightly greater predominance in the late-open class. The Mojave region exhibited the current conditions closest to reference and projected to transition very little after 50 years of climate change.

Ponderosa Pine

Ponderosa pine was recorded in three of 12 regions. The two southern regions included significant acreages – Mojave (~26,000) and Clover (~6,000), while the Calcareous includes only about 100 acres. Currently, ponderosa pine in the Mojave region occurred predominantly in the late-closed class with no annual grass invasion indicated. Ponderosa pine in the Clover region occurred predominantly in the mid-closed and mid-open classes with 11% annual grass invasion into tree stands. Climate change modeling projected a partial transition from late-closed into mid-open and late-open classes in the Mojave accompanied by a 17% invasion of annual grasses into tree stands (tree-annual grass). In the Clover region, the transition occurred from mid-open/late-open into late-open/late-closed accompanied by an 18% increase in annual-grass invaded acreage (11% currently to 29% in 50 years). In the very small Calcareous acreage, significant transitioning occurred from mid-open back to early (fire), accompanied by a 20% invasion of annual grass into tree stands. The Elko region was projected to receive somewhere between 100 and 200 acres where none was recorded to occur before. This probably should be treated as a modeling anomaly.

Spruce/Fir

Three regions contained acreages of the spruce/fir BpS – Black Rock, Elko, and Calcareous. No uncharacteristic classes were identified, and current seral conditions varied greatly between the three. In the Black Rock region, 82% of the BpS was in the early stage. The Calcareous region was characterized by a slight predominance in the mid1-open class with deficiencies in all other classes. The Elko region exhibited a predominance of acreage in the mid1-open class roughly equal to the total in late-closed that would be normally expected under reference conditions – or put another way, instead of exhibiting 42% late-closed, the Elko region exhibited 41% mid1-open. Climate change modeling projected normal transitioning from early classes to later classes in the Black Rock, a redistribution from mid1-open into other classes in the Calcareous region, and significant transitioning from early and mid1-open into mid1-closed and late-closed classes in the Elko region. All three regions were projected to increase in overall acres of spruce/fir ranging from six percent (Calcareous) to 11% (Elko).

Possible Wildlife Responses to Climate Change

The transitions projected by climate change analysis were quite diverse both between BpS's and between regions within BpS's; therefore, predictions of wildlife response are complex and require complicated discussion that calls out regional effects within each BpS. Generally speaking, there are two major guilds of forest-associated species – late-closed and mid-open/late-open. The late-closed classes would be expected to provide suitable habitat for nesting Northern Goshawks and forest-roosting bats (hoary, silver-haired, long-eared myotis). The mid-open/late-open classes would be characterized by a vigorous shrub mid-story of chaparral, mountain brush, or sagebrush, and wildlife use would thus be heavily influenced by that shrub layer – Dusky Grouse, Mountain Quail, and mule deer favoring mid-open, and Flammulated Owls, Lewis's Woodpecker, Olive-sided Flycatcher, and the shrews favoring late-open with larger diameter trees, more large-dbh snags for cavity-nesting (Flammulated Owl and Lewis's Woodpecker) and foraging (Olive-sided Flycatcher), and more down woody accumulation on the forest floor (shrews). The Lewis's Woodpecker, a fire-facilitated increaser in coniferous forest, can also utilize the early class as long as fire-killed snags are still standing, but would be expected to vacate a stand as it transitioned into the sapling mid-closed class. The GBBO Report predicted increases in Cassin's Finch populations in three BpS's in Intermountain Conifer. In the Snake Range, bighorn sheep have been noted to heavily forage in the early-succession class of subalpine conifers after fire.

Mixed Conifer

A general closing of mixed conifer stands in the Black Rock region would tend to favor Northern Goshawk nesting and forest bat roosting. The Elko region is projected to pick up as much as 17% new mixed conifer acreage, but apparently this new acreage will still be in the early classes in 50 years and less desirable to most forest priority species. Some transitioning into late-closed in the Elko region is expected to favor Northern Goshawk nesting and forest bat roosting. A neutral effect for the open-stand guild would have to be projected since stand characteristics within the tree-annual grass class are not known. Transitions from late-closed to earlier classes in the Mojave might result is a reduction in Northern Goshawk nest suitability, while stasis in the mid-open/late-open classes would likely result in a neutral response from Flammulated Owls and other priority species in the open guild. The GBBO Report predicted an increase of about five percent for Olive-sided Flycatchers in Mixed Conifer in the interior of the state.

Limber/Bristlecone Pine

Priority species use in the limber/bristlecone pine BpS is the least understood of any forest community discussed in this chapter. Northern Goshawk nesting is less likely in limber/bristlecone pine than in mixed conifer or spruce/fir, but Flammulated Owl use of the community has been documented (Mika, 2007). Dusky Grouse could be expected in all three seral classes, but likely are more preferential of the two later classes toward the high end of crown cover. The "sparse ground cover" typical of limber/bristlecone pine would tend to work against Mountain Quail use, except around ecotones with mountain brush or mountain mahogany sites. Lacking more specific information, the same response would be expected from the shrews. Humboldt yellow-pine chipmunks are known to live in the understory-deficient limber pine stands in the Pine Forest Range (Black Rock Plateau region) and it is hypothesized that the lack of shrub layer in these mineral soil/talus-floored stands acts as a functional barrier preventing least chipmunks from colonizing and possibly outcompeting the yellow-pine chipmunk (NDOW, 2006). Forest bat roosting would be expected to be more prevalent in the higher crown cover classes (mid and late-open). Since limber/bristlecone pine appeared to be tracking toward the two older classes, its value as wildlife habitat appeared to increase in all regions with climate change.

Ponderosa Pine

Ponderosa pine in the Mojave region is the preferred home of the endemic Palmer's chipmunk, which favors the late-open and late closed classes with heavier occurrence of down woody material. A predicted transition from late-closed to mid-open and late-open classes attended by significant annual grass invasion in the Mojave region would warrant monitoring of Palmer's chipmunk response. A transition from late-closed to late-open might increase habitat suitability for Flammulated Owl as well as mule deer, shrews, and Dusky Grouse. The same transition would be neutral for forest-roosting bats but might result in a slight decline in suitability as Northern Goshawk nesting habitat. In the Clover region, substantial transitions from mid-closed to mid-open and from mid-open to mid-closed (both were projected with 50 years of climate change) was expected to benefit all priority forest species.

Spruce/Fir

Spruce/fir communities in the two regions with the most acreage – Elko and Calcareous – were predicted to increase in acreage (11 and nine percent) after 50 years of climate change as well as to return to ecological conditions very similar to reference conditions. A predominance of acreage in the closed classes would be expected to benefit Northern Goshawk nesting and forest bat roosting. Dusky Grouse and shrews were expected to populate all seral stages. Closing of the stands over 50 years might reduce habitat suitability for Olive-sided Flycatcher, although the occurrence of tall snags in the late-closed class might mitigate the loss of stand openings somewhat. Mule deer would be expected to prefer the mid1-open class of which there is relatively little. Mule deer use of the closed stands would depend on the occurrence and condition of shrub understory (*Vaccinium* spp.) in those stands. Cassin's Finch is expected to use all stand of cone-bearing age and Lewis's Woodpecker use would be facilitated by fire and aspen interspersion.

Taking Prescriptive Action

Management strategy development for Intermountain coniferous forests was limited to mixed conifer and ponderosa pine in the Mojave region. In the Great Basin (regions other than Mojave, Clover, and Eastern Sierra), Intermountain coniferous forests rarely receive management attention because they usually occupy very steep rocky slopes. Aerially applied prescribed burning in the closed canopy classes was selected as the treatment for Mojave mixed conifer and ponderosa pine. The prescription was modeled at a rate of 150 acres of mixed conifer per year for the full 50 years at $50 per acre. Ponderosa pine received modeled treatments of 2,000 acres per year in the closed classes for the first ten years, then 500 acres per year in the mid1-closed stage for the remaining 40 years at $50 per acre. Average annual cost was ~$8,000 for mixed conifer and ~$30,000 for ponderosa pine. In mixed conifer, a better distribution into open classes was achieved beyond what would have occurred naturally with climate change, but in ponderosa pine, almost no added benefit beyond natural climate change-influenced transition was detected.

Priority Research Needs

- Effects of fire suppression and habitat fragmentation on species in Intermountain coniferous forest and woodland habitats.
- Responses of Intermountain coniferous forests and woodlands and their associated species to different treatment types; establish management actions that are most effective and beneficial for the habitat and specific wildlife objectives.
- Long-term banding/radio-telemetry studies, coupled with experimental prescribed fire, to quantify the importance of fire (and subsequent insect outbreaks) to reproduction and survival, long-term movement patterns, spatial structure, and temporal and spatial habitat selection of Species of Conservation Priority tied to these natural processes.
- Statewide Dusky Grouse population assessment

Conservation Strategy

Goal: Thriving self-sustaining wildlife populations inhabiting diverse conifer forests and woodlands that include a full range of successional stages across Nevada.

Objective: Maintain Intermountain coniferous forest stands within the natural range of transitions allowing for effects of climate change through 2022.

Action: Perform habitat suitability assessments for coniferous forest stands based on prioritization by presence of key species with restricted ranges, elevated risk, or key stewardship management responsibility (for Nevada).

Action: Proactively manage conifer communities that need fire through wild and prescribed fires with particular focus on white fir, mixed aspen-conifer, and ponderosa pine communities.

Objective: Sustain Northern Goshawk nesting pairs at stable or increasing trend in Intermountain coniferous forests and woodlands through 2022.

"stable or increasing trend" – as measured by regularly scheduled nest surveys at intervals not to exceed five years.

Action: Investigate and quantify the degree of Northern Goshawk nesting activity in Intermountain coniferous forests and woodlands. Delineate goshawk nesting management zones through integrated landscape planning that includes aspen stands.

Objective: Maintain Dusky Grouse populations at current levels or increasing trend through 2022.

"current levels or increasing trend" – as measured by hunter harvest questionnaire and wing bee adult/juvenile ratios.

Action: Conduct population status assessments for Dusky Grouse in key population centers, including the Spring Mountains in Clark County. Definitively delineate Dusky Grouse from Sooty Grouse ranges, particularly along the interface that exists in the Wassuk Range and White Mountains (Mineral and Esmeralda counties).

Objective: Maintain current distribution of Flammulated Owl nesting pairs through 2022.

"current distribution" – no net loss of occupancy as measured by specific nesting pair surveys conducted at scheduled intervals not to exceed five years.

Action: Conduct periodic nocturnal call playback surveys for Flammulated Owls at historically occupied sites and other suitable habitat.

Objective: Increase Mountain Quail distribution 10% by 2022.

"distribution" – distinct geographic locations where Mountain Quail occur.

Action: Maintain a trap and transplant program for Mountain Quail with the necessary public land use planning clearances approved for action when opportunity exists.

Objective: Maintain populations of other birds of conservation priority at stable or increasing trend through 2022.

"other birds of conservation priority" – Lewis's Woodpecker; Olive-sided Flycatcher; Cassin's Finch
"stable or increasing trend" – as measured by USGS Breeding Bird Survey or Nevada Bird Count

Action: Support volunteer staffing of USGS BBS routes and Nevada Bird Count transects, including NDOW staff participation.

Objective: Maintain current distribution of mule deer in Intermountain coniferous forests and woodlands through 2022.

Action: Manage Intermountain coniferous forests and woodlands for increased mountain brush understory in integrated landscape strategies that also provide closed-canopy conditions for nesting Northern Goshawks where necessary.

Objective: Maintain other mammals of conservation priority at detectable levels through 2022.

"other mammals of conservation priority" – Palmer's chipmunk; hoary bat; Humboldt yellow-pine chipmunk; Inyo shrew; montane shrew; Allen's big-eared bat; long-eared myotis; silver-haired bat.

"detectable levels" – as measured by live trap or ANABAT surveillance surveys conducted at scheduled intervals not to exceed five years.

Action: Develop and implement surveillance surveys designed to record presence/absence and compute occupancy rates of priority small mammals and forest-roosting bats.

Action: Initiate a species investigation study for Allen's big-eared bat in Nevada. Develop a rough population estimate, delineate habitat preferences, and determine key natural history traits and needs pertinent to successful management.

Action: Determine the nature and extent of hoary bat occurrence in Nevada's Intermountain coniferous forests and woodlands – key migratory periods; staging proclivities and key locations; summer residency/breeding if at all.

Action: Provide mitigative strategies to minimize hoary bat and silver-haired bat mortality to wind turbines. Participate in monitoring to adaptively manage wind turbine installations post-construction.

Objective: Maintain reptiles of conservation priority at detectable levels in Intermountain coniferous forests and woodlands through 2022.

"reptiles of conservation priority" – Sonoran mountain kingsnake; Western red-tailed skink; northern rubber boa.

"detectable levels" – as determined by surveillance surveys (ocular, pit trap, night drive, etc.) conducted at scheduled intervals not to exceed five years.

Action: Include an array of Intermountain coniferous forest and woodland sites in a statewide surveillance survey for reptiles.

Action: Initiate species investigations of Western red-tailed skink and northern rubber boa for the purpose of developing a rough understanding of range, distribution, relative densities, habitat preferences, and management needs.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
U.S. Forest Service	71
Bureau of Land Management	14
National Park Service	6
U.S. Fish & Wildlife Service	6
Other	3

Existing partnerships, plans, and programs

Multi-partner

- Spring Mountains National Recreation Area Conservation Agreement
- Forest Stewardship Program

Federal & State Agencies

- U. S. Forest Service
- Bureau of Land Management
- Great Basin National Park
- U. S. Fish and Wildlife Service
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Natural Heritage Program

Conservation Organizations

- The Nature Conservancy
- National Audubon Society/Lahontan Audubon Society
- Sierra Club
- Eastern Nevada Landscape Coalition

Bird Initiatives

- Partners In Flight – North American Land Bird Conservation Plan
- Nevada Partners in Flight – Nevada Bird Conservation Plan

Other Key Partners

- University of Nevada (UNR Biological Resources Research Center; Natural Resources and Environmental Sciences; UNLV Department of Biological Sciences)
- Great Basin Bird Observatory
- Counties
- Intermountain West Joint Venture
- Sportsman’s groups

Focal Areas

Cherry Creek Range
East Humboldt Range
Independence Mountains
Jarbidge Wilderness
Las Vegas Valley
Ruby Mountains
Snake Range
Spring Mountains
Toiyabe Range
Toquima Range
Wassuk Range

Flammulated Owl Photo Courtesy of B. Goodman

Sierra Coniferous Forests & Woodlands

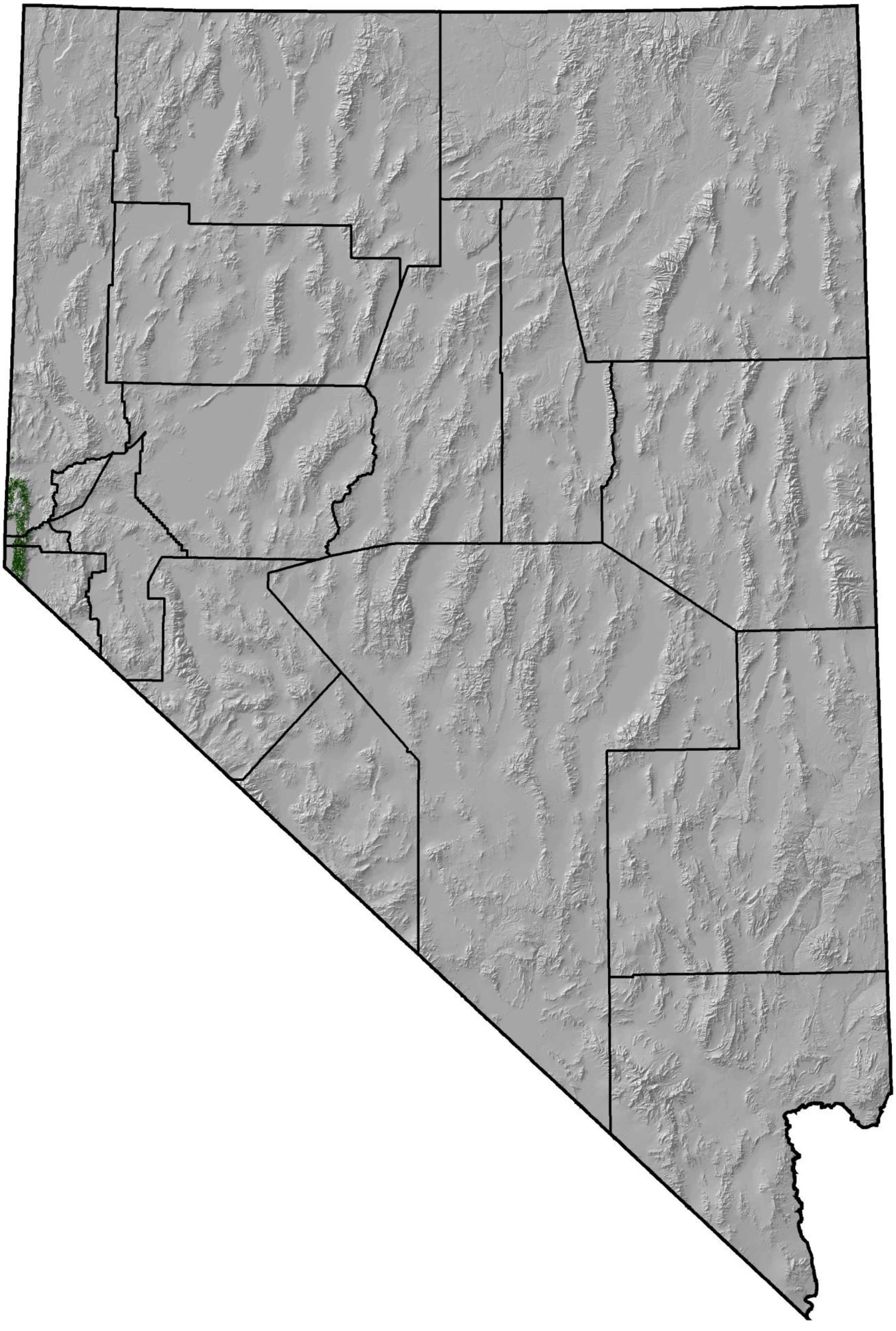


Figure 11. Distribution of Sierra Coniferous Forests and Woodlands in Nevada.

KEY HABITAT: SIERRA CONIFEROUS FORESTS AND WOODLANDS

Things to Know….

- Sierra coniferous forests and woodlands range from the foothills of the Sierra Nevada up to the timberline ridges. Conifer species found within this range is white fire, Jeffrey pine, incense cedar, ponderosa pine, and sugar pine.
- Key priority species found within this unique habitat type include the forest associated bat species (long-eared myotis), Northern Goshawk, California Spotted Owl, American marten, and Aplodontia.
- The greatest habitat threat to this habitat is altered fire regime.
- Climate change effects will improve the mixed conifers classes by moving the vegetation from early to mid or late successional stages. White fir benefits from climate change.
- Management recommendations calls for a reduction in overabundant young close-canopied forests and management of invading cheatgrass..

Ecoregions

Southwest ReGAP 2005

Great Basin	0 hectares	0 acres
Columbia Plateau	0 hectares	0 acres
Mojave	0 hectares	0 acres
Sierra Nevada	27,622 hectares	68,202 acres
Total	27,622 hectares	68,202 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Subalpine Woodland	S029 Northern Pacific Mesic Subalpine Woodland
Mixed Conifer	S033 Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland
Red Fir	S121 Mediterranean California Red Fir Forest and Woodland
Lodgepole Pine Dry	S122 Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland
Lodgepole Pine Wet	S122 Sierra Nevada Subalpine Lodgepole Pine forest and Woodland
Jeffrey Pine	S123 Mediterranean California Ponderosa-Jeffrey Pine Forest and Woodland

Key Habitat Description

Sierra coniferous forests and woodlands are comprised of a diverse assemblage of ecological systems that range from the Sierra Nevada foothills up to ridges and rocky slopes around timberline (2,700 meters [8,200 feet]). Mixed conifer forests and woodlands typify the lower elevation systems. These forested systems form closed, multilayered canopies with shrubs present in the understory where openings occur. Common conifer species of the mixed conifer forest and woodland ecological system include white fir, Jeffrey pine, incense cedar, ponderosa pine, and sugar pine (NatureServe, 2004). White fir tends to be the most ubiquitous species since it is shade tolerant and has the ability to survive long periods of suppression in brush fields.

Jeffrey and ponderosa pine forests and woodlands are found on warm, xeric sites in the Sierra Nevada foothills and mountains and are generally segregated by soil fertility and temperature regimes (NatureServe, 2004). Jeffrey pine is the dominant species on the Nevada side of the Sierra Nevada (often called “eastern yellow pine”) because it is better adapted to xeric sites at lower elevations, on south-facing slopes, or on well-drained soils. Ponderosa pine is more frequent on the California side of the Sierra Nevada but can be found in Nevada on moist and productive soils at lower to moderate elevations. Western white pine is frequently associated with Jeffrey pine, sometimes co-dominant, on the western slope of the Carson Range. Dominant shrub layer species include antelope bitterbrush, rabbitbrush, and sagebrush at lower elevations and squaw currant, snowbush, and greenleaf manzanita at all elevations. Common herbaceous species include squirreltail, blue wildrye, slender hairgrass, western needle-grass, woolly wyethia, and pennyroyal (Deukmejian et al., 1988).

Moving up the slope, conifer forest and woodlands include lodgepole pine, red fir, and the subalpine conifer systems. Red fir conifer forests and woodlands are located in higher elevations, above mixed conifer forest, and heavy snowpack is a major source of soil moisture throughout the growing season. Forest stand structure is typified by even-aged red fir trees with very few other plant species present in any other layer. Western white pine is often dominant to co-dominant with red fir on the west slopes of the Carson Range.

Another conifer system, lodgepole pine, typically forms stands of similarly sized trees, and is widespread in glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada (NatureServe, 2004). Lodgepole pine occurs in two very different biophysical settings in the Sierra Nevada – “dry” and “wet.” The dry lodgepole BpS occurs on upper montane and subalpine dry sites on benches and moderate slopes in nutrient poor granitic or pumice soils. Individual trees can reach large diameters and stands are often woodlands. Forest understory is typically sparse with few shrubs and low-to-moderate herbaceous cover. The Carson Range offers many examples of this dominant type of lodgepole pine. Wet cold lodgepole pine occurs on upper montane sites usually on gently rolling lower slopes and drainage bottoms where soils might be water-logged. This BpS resembles most the Rocky Mountain lodgepole pine BpS. Sites are moist to wet and more productive than dry cool subalpine lodgepole. Fuels are composed of a matrix of herbaceous vegetation and pine debris. The understory is diverse with graminoids and forbs (cover >50%). Tree cover is generally moderate to dense and individual trees are rarely of large diameter. Few other species are co-dominants with lodgepole pine but occasional associates include aspen and mountain hemlock. The understory component of lodgepole pine forests is usually sparse consisting of scattered shrubs and herbs, or a rich herbaceous layer at meadow margins (Deukmejian et al., 1988). A few good examples of the wet type are found in Little Valley west of Washoe Valley.

Northern Pacific mesic subalpine woodlands occur on ridges and rocky slopes around timberline on concave or mesic slopes in areas with long-lasting snowpack and better soil development than other drier and more exposed subalpine woodlands. Characteristic species include mountain hemlock, red fir, whitebark pine, and juniper, as well as patches of grasses, sedges, and forbs grading into adjacent meadows (NatureServe, 2004).

Value to Wildlife

Wildlife depend on a variety of features for foraging, roosting, and nesting provided by conifer forests and woodlands that include mesic microsites, mid-story structure, and mature canopy. Forest-associated bat species (e.g., long-eared myotis) day-roost in hollow trees or under exfoliating bark (Bradley et al., 2004). In addition, some wildlife in conifer forests and woodlands primarily make use of the conifer-riparian ecotone because of the diversity of plant growth and edge conditions in these areas (Hill, 1995). Young, early successional conifer forests provide dense foliage and vegetation for species that prefer understory cover, particularly small mammals. These species are tied to forage access and protection from predators. Old growth forests can also provide this structure since they have treefall and windthrow gaps in the canopy, large downed logs, rotting woody material, and tree seedling establishment on logs or on mineral soils unearthed in root balls (NatureServe, 2004). Openings in the dominant canopy facilitate vegetation regeneration on the forest floor which provides favorable habitat for the species utilizing understory cover. Other wildlife species respond to the prey populations that inhabit the forest understory (e.g., Northern Goshawk). Typically these species are wide-ranging, and their habitat use is driven more by prey availability than the actual habitat features.

Natural disturbances that plague many western second growth stands, including insect epidemics, disease outbreaks, and fire, are less likely to have catastrophic consequences in Sierra Nevada old growth conifer forests and woodlands. Old growth forests and woodlands provide structural complexity (many trees in different diameter classes), high canopy closure, and downed wood, and some wildlife species require old growth forests for various portions of their life histories. Priority species requiring old growth include American marten, whose optimum habitat elements appear to be mature old growth spruce-fir communities with greater than 30% canopy cover, and a well-established understory of fallen logs and stumps and understory vegetation supporting small mammal prey (Clark et al., 1987); California Spotted Owls, requiring large trees (greater than 90 centimeters diameter at breast height) for foraging and nesting (Gutierrez et al., 1995); and, White-headed Woodpeckers, requiring abundant mature pines (with large cones and abundant seed production), a relatively open canopy (50 to 70%), and snag and stump availability for nest cavities (Garrett et al., 1996).

The Sierra coniferous forest remnants that harbor wildlife species uniquely adapted to live in old growth habitats are important because many of these species are found nowhere else in Nevada. Mature or old growth conifer forests are also valuable to wildlife because they provide an abundance of insect-infected snags or dying trees. Trees with heart rot provide the essential substrate for cavity excavation which is important for wildlife nesting, and dying trees provide an insect prey base for foraging. Northern flying squirrels nest in red fir with mature witch's broom growths and large DBH trees with cavities.

Sierra coniferous forests and woodlands also provide foraging habitat for aerial feeders (e.g., bats). Some species are tied to temporal disturbances in these habitats (e.g., Lewis's Woodpecker), because they require the resulting insect outbreaks (Leonard, 2001). Although Sierra coniferous forests and woodlands comprise only a small portion of Nevada's key habitats, they are valuable for wildlife and play an essential role in conservation planning for the state's wildlife.

Key Elements of Sierra Coniferous Forests and Woodlands Habitat Important to Wildlife

OVERSTORY CANOPY – nesting structure, roosting, protection from predators

Sooty Grouse
Cassin's Finch
hoary bat
silver-haired bat
long-eared myotis

SHRUB AND HERBACEOUS COVER – protection from predators, foraging, thermal cover

Mountain Quail
Sierra Nevada snowshoe hare
montane shrew
mule deer
Sierra alligator lizard

OLD GROWTH – mature structure for nesting and roosting, denning (downed wood), burrowing (deep soils), foraging (downed wood and understory vegetation supports small mammal populations), snags, cavities

Bald Eagle
California Spotted Owl
Northern Goshawk
White-headed Woodpecker
Flammulated Owl
Olive-sided Flycatchernorthern flying squirrel
shadow (Allen's) chipmunk
long-eared myotis
American marten

DISTURBANCE – fire or insect outbreaks create suitable conditions for foraging (increased insects) and nesting (substrate for cavity excavation)

Lewis's Woodpecker

RIPARIAN/WET MEADOW ECOTONE – foraging (diversity of plant growth), protection from predators and nesting (edge conditions resulting in dense cover)

mountain pocket gopher
spotted bat
little brown bat
Aplodontia

Existing Environment

Land Uses

- Urban/suburban development
- Motorized recreation – snowmobiles, OHVs
- Non-motorized recreation – hiking, camping, back country skiing
- Recreation development – ski areas, snow parks, developed campgrounds and day-use areas
- Species harvest

Habitat Conditions

The Comstock mining era had a profound effect on the Sierra coniferous forests and woodlands with wood being extracted for building, mining timbers, and fuel wood for domestic purposes, and power mills, crushing ore, and for hoisting works in the mines. Between 1860 and 1875 the Carson Range was completely cut over and the timber of the Tahoe Basin began to be harvested. During this time, little thought was given to stand improvement, species diversity, or leaving a seed source for future stands. As a result, most old growth conifer forest habitat in the Carson Range was eliminated, and the landscape is now dominated by second growth conifer forests. These second growth forests contain trees all relatively similar in age and the white fir component is much greater than pre-settlement forest. Fire suppression beginning in the 1920s fostered the retention of an unnatural proportion of white fir in the forest community, and dead woody material has accumulated to dangerously high levels on the more productive sites. The drought of the early 1990s coupled with epidemic insect infestations resulted in mortality of most white fir and Jeffrey pine that was under 120 years-old. This combination of factors has contributed to the current cycle of rapid stand collapse and regrowth, which replaced a cycle of gradual changes.

Problems Facing the Species and Habitats

The altered fire regime of Sierra coniferous forests and woodlands is the most daunting challenge wildlife species and these habitats are currently facing. Many years of fire suppression have resulted in abnormally high fuel levels. Combined with the conifer mortality resulting from fir engraver beetles (white fir) and bark beetles (lodgepole and Jeffrey pine) and increases of the highly flammable invasive cheatgrass, particularly at lower elevations, restoring equilibrium to this habitat will take very proactive management with no guarantee that valuable wildlife habitat won't be lost to future catastrophic events. Another challenge to modifying the current practice of high fire suppression is the proximity of this habitat to the urban interface and resultant concerns for human safety and potential economic loss.

Sierra coniferous forests and woodlands experience significant pressure from urban and suburban development. In fact, the undeveloped area of the Sierra Nevada phytographic region was by far the smallest of all 14 Nevada regions because urban areas and Lake Tahoe represent >50% of an already small total area. This meant that estimates of ecological departures for the Sierra Nevada's region ecological systems, especially its forest types, could be inaccurate due to their small size. Development has and will continue to result in permanent habitat loss or conversion, inflict direct mortality, and fragment wildlife habitat if conservation of these forest habitats and their associated species is not incorporated into the planning process. An increasing human population is coupled with the need for infrastructure (e.g., road, utility corridors) that can serve as a conduit for invasive species such as cheatgrass, and result in additional forest fragmentation. The Sierra Nevada provides multiple recreation opportunities that are sources of stress for wildlife and their habitats, including non-motorized (e.g., hiking, back-country skiing) and motorized (e.g., OHVs, snowmobiles) recreational pursuits. OHV use in the area is mostly concentrated on Peavine Mountain. Ski areas, snow parks, and developed day-use areas and campgrounds also facilitate increased disturbance to wildlife and alter the habitat through the removal of vegetation and soil compaction.

Although current forestry practices are designed to address stand health, conifer forests and woodlands in the Sierra Nevada are still recovering from historic forestry practices during the Comstock era. Wildlife species and their habitats in the Carson Range are subject to increases in noxious weeds, habitat conversion, fragmentation, and population isolation due to the pressures of urbanization. For example, mule deer migration corridors are intersected by major highways and urban development, resulting in increased vehicle collision mortalities and restricted movement of mule deer in and out of the Carson Range. Consequently, the Carson Range, like other mountain ranges in Nevada, is becoming isolated from adjacent landscapes. This circumstance may ultimately result in decreased genetic variability of populations and increased risk of localized species extirpations as a result of environmental stochastic events.

Predicted Effects of Climate Change

The Nature Conservancy climate change analysis did not include the portion of the Tahoe Basin that occurs in Nevada because it had been analyzed in another recent report – "Forecasting the Response of Terrestrial

Habitats to Climate Change in the Northern Sierra: Climate Change Adaptation Strategies for the Northern Sierra Partnership" (TNC, 2011), hereafter named in this document "The Northern Sierra Report." While ecological condition assessments for the forest types unique to the Nevada Tahoe Basin cannot be specifically separated out of the Northern Sierra Report, they can be discussed in terms comprehensive to the Northern Sierra Nevada and applied to Nevada's climate change predictive analysis in an extrapolated manner. The hypotheses of climate change proposed in this report were first formulated in TNC's Northern Sierra Report.

For the purpose of this discussion, we included all coniferous forest acreages in the Eastern Sierra region even though we knew there were a few stands outside the Sierra Nevada proper. We used the Northern Sierra Report to gain insight into the coniferous forest types not inventoried in the Eastern Sierra region (Lodgepole Pine, Red Fir, Subalpine Woodland).

Mixed Conifer

Currently, the mixed conifer BpS in the Eastern Sierra region predominantly exists in the early stage (less than 50 years old – 67%), with 25% in the mid-successional stages and a serious deficiency in the late classes. Modeling results for 50 years of climate change predicted a significant shift from the early class to mid-successional stages (predominantly mid-open), and a doubling of percentage in late classes (7 to 16%), but late classes would still only represent a little over one-third the total found in reference condition. This could likely reflect the phenomenon of this type having been heavily harvested over a relatively short period of time (Comstock logging period), sending the BpS into even-aged stand cycling vulnerable to heavy insect infestation and catastrophic fire prior to reaching maturity. Also important is the prediction that the mixed conifer BpS would increase at the expense of other BpS's, i.e., mixed conifers, especially white fir, benefit from climate change because their fast growing species are fertilized by increasing CO_2.

Jeffrey Pine

Similar to mixed conifer, the Jeffrey pine BpS currently exists in the early and mid-successional stages. In reference condition, 50% of the type should be in late-open class, but currently only 13% exists in the late-open class. Results of climate change modeling indicated significant transitioning from the early class to the mid-successional classes and a slight increase in late classes with transitioning from late-open to late-closed. Uncharacteristic classes with non-native annual grasses (cheatgrass) were also projected to increase from six percent to a total of 14%, therefore continuing a trend already observed by US Forest Service field staff (personal communication, 2011).

Red Fir

Two biophysical settings involving red fir were identified in the Northern Sierra Report – Red Fir-Western White Pine and Red Fir-White Fir. The red fir-western white pine type is the most common in the Carson Range. Neither type registered in the Eastern Sierra region inventory. In the Northern Sierra Report, the two red fir types were characterized as predominant in the mid-successional stages (68 and 72%) and deficient in the late classes 20 and 25% in the inventory; 56% reference). No uncharacteristic classes were identified in the report. Both red fir types were projected to improve in ecological departure with 50 years of climate change. While the actual range of percentages for the climate change projection were not available from the Northern Sierra Report, it can be assumed that transitioning from mid-successional to late-successional stages occurred. Some conversion to other types was predicted – seven percent for red fir-western white pine and two percent for red fir-white fir. Also significant, the red fir BpS is predicted to gain area at the expense of subalpine conifers while losing ground to mixed conifers and chaparral.

Lodgepole Pine

Neither dry nor wet lodgepole BpS registered in the Eastern Sierra region inventory, but both are present on the Carson Range. The Northern Sierra Report indicated that both lodgepole communities were currently uncharacteristically heavy in late successional stages. Climate change modeling indicated that dry lodgepole would continue to age, transitioning from mid-open to late-open and from late-open to late-closed with a seven percent conversion to red fir and mixed conifer. Specific transitioning results for wet lodgepole were not made available through the report because this vegetation type is much less abundant in the Carson Range.

Subalpine Woodland

In Nevada, the subalpine woodland BpS is predominantly represented by whitebark pine and mountain hemlock, and none registered in the Eastern Sierra region inventory although the type is present on the Carson Range, so the following inferences come from the Northern Sierra Report. The subalpine woodland BpS currently exists fairly close to reference condition. Within mid-successional stages, there is a preponderance of mid-open over mid-closed and within the late classes there is a preponderance of late-open over late-closed, but the two-class totals for each of those stages were fairly close to reference. No uncharacteristic classes were identified in the report. Ecological departure increased slightly with 50 years of climate change (modeled), but remained in what is considered to be “good” condition. The nature of the increase in ecological departure (transitioning between classes) could not be derived from the report. Among all Sierra Nevada conifer BpS’s, the subalpine conifer BpS is expected to experience the greatest loss of area to conversion by >70%. TNC’s report also indicated that two important elevational refugia for the subalpine conifer BpS are Mt. Rose and the Carson-Iceberg Wilderness (California).

Possible Wildlife Responses to Climate Change

Mixed Conifer

All priority species were expected to be encountered in mixed conifer with the partial exception of Lewis’s Woodpecker which is primarily associated with open or burned Jeffrey Pine and vacates pine forest when it is invaded by closed stands of mixed conifer. Climate change modeling projected a large conversion of other conifer forest types into the mixed conifer BpS and natural transitioning from early to mid-closed and a doubling of late-successional classes still significantly deficient from reference conditions. The increase in mid-successional stages was expected to benefit Sierra Nevada snowshoe hares which utilize the mixed sapling-shrub stands for day loafing adjacent to their riparian feeding areas. Mountain Quail and mule deer would likely not benefit significantly in the first 50 years until the mid-successional stands began to open out and express a more productive shrub mid-story. The long list of old growth-associated species along with forest-roosting bats would benefit some from aging of the stands, but connectivity between older stands and minimum patch size of old growth stands would likely continue to limit expansion of these species in the first 50 years. California Spotted Owls would benefit in the largest contiguous patches of late-closed class.

Jeffrey Pine

All priority species were expected to be encountered in Jeffrey pine with the exception of California Spotted Owl, which exhibits a strong preference for closed mixed conifer and a lesser association with red fir but as fortune would have it, the only nesting pair currently known to inhabit the Nevada side of the Lake Tahoe Basin live in Jeffrey pine. Wildlife responses to modeled Jeffrey pine transitions would be similar to mixed conifer. A predominance of acreage in the mid-closed class would not yet provide full benefit to Mountain Quail and mule deer and many other priority species would basically respond neutrally to the transition from early to mid-closed. The closing of older stands would improve conditions for Northern Goshawk, American marten, northern flying squirrel, shadow (Allen's) chipmunk, and forest-roosting bats, but not necessarily for Flammulated Owl, White-headed Woodpecker, or Olive-sided Flycatcher, all preferential of open stands of large-DBH (diameter breast height) pine. The GBBO *Bird Responses To Climate Change Report* hypothesized the loss of individual White-headed Woodpecker pairs at the lowest elevations where Jeffrey pine might be lost in conversion to chaparral or pinyon-juniper, but the report stopped short of predicting an increase of White-headed Woodpeckers in the mid-closed class where most Nevada Bird Count detections occurred, citing large home range size and scale and resolution issues as confounding factors. In other words, White-headed Woodpeckers could be responding to forest stand conditions at a scale too fine for the analysis to pick up. Small occurrences of late-open stands within a classification polygon could be sufficient to maintain the species in a matrix of less-than-suitable habitat otherwise detectable by the remote sensing and bird survey techniques.

Red Fir

All priority species were expected to be encountered in red fir although Sooty Grouse, White-headed Woodpecker, and Lewis's Woodpecker do not exhibit strong affinity for the type. The aging of red fir stands and improvement of ecological condition (decreased departure) was expected to benefit most all priority species that use the type. The priority species list did not appear to have a specific red-fir-facilitated species (at least in Nevada) on it such as Williamson's Sapsucker or Pine Grosbeak, although Nevada's northern flying squirrels might maximize their densities in the older age classes of red fir types.

Lodgepole Pine

All priority species were expected to be encountered in lodgepole pine although Mountain Quail, California Spotted Owl, White-headed Woodpecker, and shadow (Allen's) chipmunk are not strongly associated with the types. Continued aging of the dry lodgepole pine community was (Allen's) expected to benefit Sooty Grouse and forest-roosting bats, but the type's value to other guilds of priority species was expected to be minimal without understory. Sooty Grouse prefer feeding on new needles of older trees over younger tree classes (Remington et al. 1996). Wet lodgepole pine transitioning from late-open to late-closed would be expected to benefit Northern Goshawk, Sooty Grouse, forest-roosting bats, American marten and northern flying squirrel. Priority species positively associated with open canopy and/or shrubby understory would not benefit from ageing and canopy closure – Flammulated Owl, Olive-sided Flycatcher, Sierra Nevada snowshoe hare, montane shrew, mule deer, Sierra alligator lizard.

Subalpine Woodland

Generally speaking, the subalpine woodland BpS in Nevada supports a less diverse community of priority wildlife species because those that respond positively to tall, large DBH trees are not well-served in whitebark pine which tends to grow multiple stems of smaller diameter from common root stocks, but there are some surprises, such as American marten which uses the type despite its preference for closed canopy and buildup of down woody material. Of birds, only the Cassin's Finch and Olive-sided Flycatcher exhibit a strong affiliation with the type. In contrast, many more of priority mammals are expected to use the type – all except northern flying squirrel and shadow (Allen's) chipmunk. The current predominance of open classes in this type and an inferred tendency to open even further with climate change would tend to favor Olive-sided Flycatcher, Sierra Nevada snowshoe hare, and mule deer, and decrease habitat value for American marten. Other priority species would probably exhibit neutral response to this trend. Forest-roosting bats would be expected to shift use from roosting to foraging. All species, however, will experience increasing loss of the BpS to red fir and Jeffrey pine.

Summary

The effects of climate change on Sierra coniferous forest types as a whole were not expected to target any particular priority species or group of species for significant change in distribution or survivability over the next 50 years. Current distributions and population sizes were not expected to change dramatically, although significant range shifts among BpS's are predicted in the next 100 years. Other pressures associated with human use of the Sierra landscape are much more likely to impact occurrence and viability of Sierra coniferous habitats and the wildlife species that use them.

Taking Prescriptive Action

The Jeffrey pine and mixed conifer BpS's were simulated for management in the Wildlife Action Plan climate change analysis. The management challenge in this habitat was the reduction of over-abundant young closed-canopied forests balanced against requirements to maintain older closed-canopied vegetation classes for special-needs species management. The projected invasion of cheatgrass into open forests with climate change was considered serious enough to warrant prescriptive grazing management. See Appendix C for further details on prescriptive actions.

Priority Research Needs

- More specific delineation of the use of Sierra coniferous forest successional stages and woodlands by priority species
- Effects of fire suppression, fragmentation, forest health, forest fuels reduction and salvage logging on species in Sierra coniferous forest and woodland habitats
- Winter range, migration corridors, and population viability of mule deer herds
- Range and population viability of American marten
- Range, status and population viability of Northern flying squirrels
- Population status and range of the Sierra Nevada snowshoe hare
- Population status of Aplodontia

Conservation Strategy

Goal: Thriving, self-sustaining wildlife populations in a dynamic landscape encompassing the full range of forest successional stages, with a local emphasis on the maintenance of old growth conifer forest conditions.

Objective: Set management direction and implement prescriptive strategies by 2022 to increase old growth (late-closed) mixed conifer 10% by 2062.

Action: Implement thinning and prescribed burning in mid-closed mixed conifer stands to open stand for faster DBH growth and promote the development of multi-aged conifer and woodland stands with complex structure (e.g., old growth conditions).

Action: Conserve the remaining Sierra coniferous forests and woodlands that have retained old growth or late-successional characteristics.

Action: Update Memorandum of Understanding (MOU) between the state of Nevada and the Humboldt-Toiyabe National Forest to provide continued protection of the last significant stands of old growth in the Carson Range.

Action: Identify and recommend Sierra Nevada old growth conifer forests and woodlands significant to wildlife for special management (i.e., Special Interest Areas or Special Management Areas) by the Humboldt-Toiyabe National Forest.

Action: Review and provide comments on the final proposed Special Interest Areas and Special Management Areas including old growth Sierra coniferous forests and woodlands in the Humboldt-Toiyabe National Forest revised management plan.

Action: Work with conservation partners in the Sierra Nevada ecoregion to achieve conservation objectives for Sierra coniferous forests and woodlands across its range in order to provide a landscape mosaic that includes forests retaining old growth and late successional characteristics.

Objective: Maintain late-open (old growth) Jeffrey pine at current relative percentages (13-14 % total Jeffrey pine acreage) through 2022, against predicted trends with climate change.

Action: Implement prescriptive grazing management to early and mid-successional stages vulnerable to annual grass invasion to reduce the percentage of annual grass-invaded Jeffrey pine acreage.

Action: Allow the natural aging of mid-successional classes to progress toward late-open through intensive sapling thinning and prescribed burning in mid-successional classes to release tree growth, shrub understory development, and promote uneven-aged, multi-storied stands tracking toward open old growth condition.

Objective: Manage lodgepole pine, red fir, and subalpine woodland communities not to exceed a 10% increase in ecological departure from current conditions through 2022.

Action: Review current management strategies for wet lodgepole pine, red fir, and subalpine woodland communities to determine if current strategy is sufficient to maintain current conditions through 50 years of climate change.

Action: Evaluate the need to apply prescriptive management to dry lodgepole pine in Nevada considering total acreage and relative significance to wildlife with particular emphasis on priority species needs and responses.

Objective: Maintain five active Northern Goshawk nesting territories in the Carson Range/Lake Tahoe Basin/Peavine Mountain region of Nevada through 2022.

"five active… territories" – based on three detections in the Tahoe Basin in 2005 with one prospective active territory each for Mount Rose and Peavine Mountain; "Active territory" confirmed by visual sighting or audible response to tape playback.

Action: Conduct standardized acoustic tape playback surveys in potentially suitable Northern Goshawk nesting habitat annually or at intervals not to exceed five years.

Action: Map suitable Northern Goshawk nesting habitat with “defended territory”, “nesting pair home range”, and “post-fledging dispersal” zones delineated based on active nest information as well as goshawk habitat suitability models.

Action: As necessary, assist the Humboldt-Toiyabe National Forest and Lake Tahoe Basin Management Unit (LTBMU) in the application and update of Northern Goshawk nest territory management standards and guidelines.

Objective: Maintain a minimum of one active California Spotted Owl nest territory through 2022.

“one active… territory” – based on confirmation of nesting in Nevada in 2009.

Action: Conduct standardized surveys in potentially suitable California Spotted Owl nesting habitat annually or at intervals not to exceed five years.

Action: Map suitable California Spotted Owl nesting habitat with “defended territory,” “nesting pair home rang,”, and “post-fledging dispersal” zones delineated based on active nest information as well as spotted owl habitat suitability models.

Action: Adhere to Sierra Nevada Forest Plan Amendment management guidelines for spotted owl nesting zones.

Action: Conduct radio telemetry research on spotted owl fledglings to document juvenile dispersal, post-fledging habitat selection, and survival to document spotted owl behaviors and habitat use specific to Nevada habitat conditions.

Action: Document spotted owl prey selection specific to Nevada; assess prey population viability, relative abundance, and potential prey population management challenges.

Objective: Maintain a minimum of one active Bald Eagle nest territory in the Nevada Carson Range/Lake Tahoe Basin/Peavine Mountain region through 2022.

“one active… territory” – based on known number of Bald Eagle nest territories in Nevada Sierra Nevada since mid-1990’s.

Action: Conduct annual status surveys in confirmed Bald Eagle territories; conduct comprehensive raptor nesting aerial surveys on Nevada side of Lake Tahoe Basin at intervals not to exceed five years.

Action: Limit disturbance and extraction activities within Bald Eagle nest buffer zones in compliance with National Bald Eagle Management Guidelines (FWS 2007).

Objective: Maintain Sooty Grouse and Mountain Quail populations at harvestable levels and current range and distribution through 2022.

“harvestable levels” – as determined through standardized annual evaluation of hunter questionnaires
“current range and distribution” – no loss of known occurrence sites as currently understood.

Action: Continue to document the delineation of range and distribution between Sooty Grouse and Dusky Grouse in Nevada.

Action: Maintain mixed conifer and lodgepole pine stands in late successional stages to facilitate Sooty Grouse feeding preferences for young needles off large mature conifer trees.

Action: Maintain a balanced mix of late-open (chaparral understory for feeding and brooding) and late-closed (roosting and wintering) successional stages in Sooty Grouse and Mountain Quail habitat.

Objective: Maintain 850 White-headed Woodpeckers in suitable habitat in the Nevada Sierra Nevada through 2022.

“850 White-headed Woodpeckers” – population estimate from the Nevada Bird Conservation Plan; measured via Nevada Bird Count surveys or other specialized survey as necessary.

Action: Apply management action, including prescriptions described above, to allow the natural transition from mid-successional stages to late-open class in Jeffrey Pine and mixed conifer.

Action: Conduct Nevada Bird Count transects in the Sierra Nevada. Investigate the need to augment survey network with additional transects as indicated by statistical power analysis.

Objective: Maintain Flammulated Owl populations at detectable levels in the Nevada Sierra Nevada through 2022.

“detectable levels” – as determined via nocturnal acoustic playback surveys conducted at intervals not to exceed five years.

Action: Conduct nocturnal acoustic playback surveys at regular intervals not to exceed five years.

Action: Apply management action, including prescriptions described above, to allow the natural transition from mid-successional stages to late-open class in Jeffrey Pine and mixed conifer.

Action: Encourage Nevada participation in west-wide Flammulated Owl Status and Trend Monitoring Project as endorsed and coordinated by the Partners In Flight Western Working Group.

Objective: Increase Olive-sided Flycatcher detections by 10% in mixed conifer and Jeffrey Pine by 2022.

"Increase… detections" as measured via Nevada Bird Count/Lake Tahoe Environmental Improvement Project surveys.

"10%" – The relative percentages of late successional classes of mixed conifer and Jeffrey pine are predicted to increase a combined total of 10% with climate change without management and a total of 19% with management.

Action: As opportunities exist, continue to apply prescribed forest management to mid-successional mixed conifer stands to open stand for faster DBH growth, open foraging zones, and promote the development of multi-aged conifer and woodland stands with complex structure.

Action: During forest thinning projects, promote the selection of the tallest snags for retention for Olive-sided Flycatcher hunting perches.

Action: Continue staffing of Nevada Bird Count/Tahoe EIP breeding bird surveys and conduct at regular intervals not to exceed five years.

Objective: Maintain Lewis's Woodpecker at detectable levels in suitable habitat through 2022.

"detectable levels" – as measured via Nevada Bird Count surveys or specific post-fire monitoring projects.

"suitable habitat" – in the Sierra Nevada, Lewis's Woodpeckers are more responsive to post-fire conditions than in other regions of the state; therefore, Lewis's Woodpecker occupancy and detectability in the Nevada Sierra Nevada is expected to be highest in recently burned areas before significant fall of snags and fire-killed trees occurs.

Action: Conduct post-fire wildlife surveys as regular protocol to measure wildlife response to catastrophic change as well as recovery.

Action: As standard protocol for fire wood salvage projects, leave at least 50% of standing dead trees intact for natural fall on a recent burn to facilitate the foraging and reproductive needs of Lewis's Woodpecker and other fire-facilitated wildlife species.

Objective: Maintain mule deer populations at current levels in the Nevada Sierra Nevada through 2022.

"current levels" – as determined by NDOW deer surveys

Action: Apply prescriptive management to mixed conifer and Jeffrey Pine stands designed to transition "closed" classes to "open" classes conducive to chaparral and mountain brush expansion.

Objective: Maintain forest-dwelling priority bat populations at detectable levels for all species in the Nevada Sierra Nevada through 2022.

"forest-dwelling priority bats" – hoary bat, silver-haired bat, spotted bat, long-eared myotis, little brown bat. "dectectable levels" – as measured by ANABAT acoustic surveys conducted at regular intervals not to exceed five years.

Action: Conduct surveillance ANABAT acoustic surveys in all five forest BpS's at regular intervals not to exceed five years.

Action: Promote active and passive management strategies that encourage the natural transitioning of mid-successional classes to late-successional to promote better bat roosting conditions e.g. tall mature trees, closed canopies, cavities, exfoliating bark.

Action: Promote snag retention strategies in treatment/salvage/commercial harvest zones.

Objective: Maintain priority terrestrial mammal populations at detectable levels for all species in the Nevada Sierra Nevada through 2022.

"priority terrestrial mammals" – Sierra Nevada snowshoe hare; montane shrew; American marten; northern flying squirrel; shadow (Allen's) chipmunk; mountain pocket gopher.

"detectable levels" – as measured via live trap survey or remote camera array to be implemented at regular intervals not to exceed five years.

Action: Continue current radio telemetry monitoring research for northern flying squirrel and Sierra Nevada snowshoe hare with emphasis on relative abundance, range and distribution, and habitat preference.

Action: Initiate radio telemetry studies for American marten with emphasis on determining home range size, habitat preference, and suitable habitat connectivity analysis.

Action: Initiate a habitat preference study for shadow (Allen's) chipmunk for the purpose of developing a functional suitable habitat model to predict distribution and relative abundance.

Objective: Maintain Sierra Nevada alligator lizard at detectable levels in suitable habitats in the Nevada Sierra Nevada through 2022.

"suitable habitat" – as delineated through discovery surveys or a basic range and distribution investigative study.

Action: Initiate discovery surveys starting with areas of known occurrence and expanding into locations of similar habitat for the purpose of developing a cursory habitat preference model and preliminary sense of relative abundance.
Action: If deemed warranted as a result of initial investigations, develop a more detailed species assessment project with emphasis on completing a full range assessment, measured relative abundance, vetted suitable habitat model, and connectivity analysis.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
U.S. Forest Service	75
Private	13
State of Nevada	9
Other	3

Existing partnerships, plans, and programs

Multi-partner
- Spooner Summit Old Growth Cooperative Agreement (1993)
- Forest Stewardship Program

Federal & State Agencies
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service/Conservation Districts
- Nevada Division of State Parks
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Natural Heritage Program

Conservation Organizations
- Lahontan Audubon Society
- The Nature Conservancy
- Sierra Club

Bird Initiatives
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners in Flight
- Nevada Bat Conservation Plan

Other Key Partners
- Tahoe Regional Planning Agency
- Carson City; Washoe and Douglas Counties
- University of Nevada, Reno
- Great Basin Bird Observatory

Focal Area

Carson Range

Grasslands & Meadows

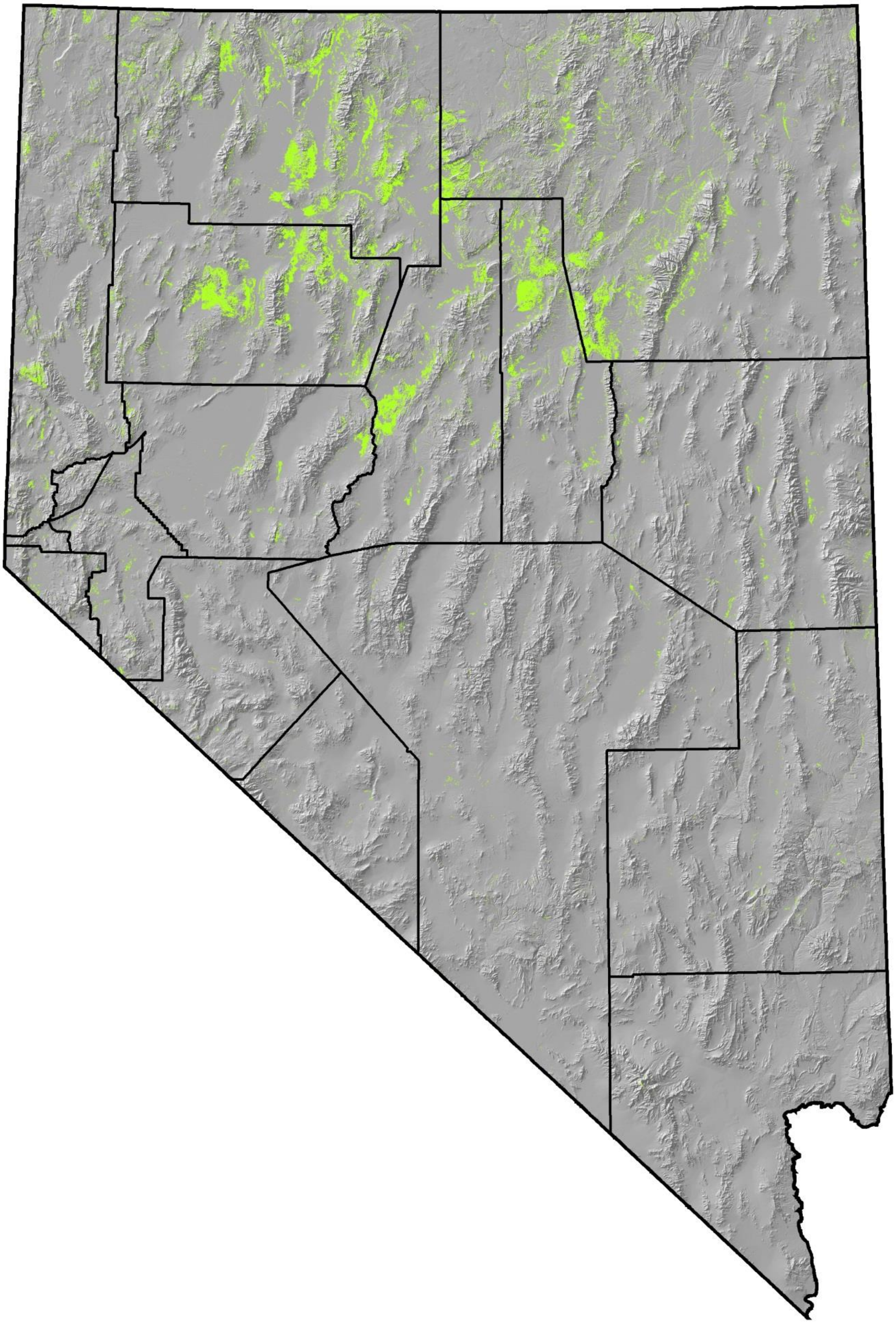


Figure 12. Distribution of Grasslands and Meadows in Nevada.

KEY HABITAT: GRASSLANDS AND MEADOWS

Things to Know….

- Grasslands and meadows in Nevada are distributed widely throughout the state and differ from one another. Grasslands differ from wet meadows as they are found on xeric sites or sites with periods of dryness throughout the year.
- Wildlife uses depends upon the vegetation community and associated habitats. Species of Conservation Priority, such as Short-eared Owl, Prairie Falcon, and dusky shrew utilize this habitat.
- Issues that affect this habitat include excessive grazing by ungulates and loss of grass seed production.
- Climate change effects within this habitat type include conversions to shrub communities and tree encroachment.

Ecoregions

Southwest ReGAP 2005

High Elevation Meadow		
Great Basin	5 hectares	12 acres
Columbia Plateau	1,101 hectares	2,719 acres
Mojave	74 hectares	183 acres
Sierra Nevada	1,044 hectares	2,577 acres
Total	2,224 hectares	5,490 acres

Low Elevation Grasslands		
Great Basin		
Columbia Plateau	2,959 hectares	7,306 acres
Mojave		
Sierra Nevada		
Total	2,959 hectares	7,306 acres

Semi-desert grasslands		
Great Basin	51,919 hectares	128,194 acres
Columbia Plateau	16,367 hectares	40,411 acres
Mojave	1,788 hectares	4,416 acres
Sierra Nevada		
Total	70,074 hectares	173,021 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
	S083 Southern Rocky Mountain Montane-Subalpine Grassland
High Elevation Meadow…………………	S084 Mediterranean California Subalpine Meadow
	S085 Rocky Mountain Subalpine Mesic Meadow
	S134 North Pacific Montane Grassland
	S090 Intermountain Basins Semi-desert Grasslands

Key Habitat Description

This key habitat type encompasses a collection of disparately distributed grassland types that are not particularly similar to one another, except that they are distinguished from wet meadow types by either occurring on xeric sites or at least drying out some part of the year. Short descriptions of each are provided below:

High Elevation Meadow

This biophysical setting occurs on gentle to moderate-gradient slopes in the subalpine zone typically above 2000 m (6,600 ft) in elevation in Nevada. The soils are fine, dominated by organic matter, and seasonally moist to saturated in the spring, but will dry out later in the growing season. The vegetation of Columbia Plateau sites is typically forb-rich, with forbs contributing more to overall herbaceous cover than graminoids. Important taxa include *Erigeron*, *Senecio*, *Helianthella, Mertensia*, penstemon, lupine, balsamroot, and *Wyethia*,. Fires are primarily replacement and occur about every 40 years, entering from adjacent shrub or tree dominated sites, such as mountain big sagebrush, white fir, limber pine, and aspen. In the Sierra Nevada, this type's analog (Mediterranean California Subalpine Meadow) is dominated by yarrow, alpine aster, and other Sierra forbs. Another Sierra Nevada meadow type (North Pacific Montane Grassland) is typically intermixed with matrix stands of red fir, lodgepole pine, and mixed conifer forests and woodlands. Dominant species include *Elymus*, Idaho fescue, lupine, *Carex*, *Scirpus*, and *Juncus*. Fire interval is similar to Columbia Plateau types.

Low Elevation Grassland

This ecological system typically occurs between 2,200-3,000 m (7,200-9,800 ft) on flat to rolling plains and dry benches in northern Nevada's Columbia Plateau. Key bunchgrasses include Idaho fescue, Great Basin wildrye, bluebunch wheatgrass, and Sandberg's bluegrass. In Nevada, patches are mixed with mountain shrub and mountain big sagebrush. Historic fire interval was probably 20 years.

Semi-desert Grassland

This ecological system is found at approximately 4,200-5,000 ft of elevation on xeric sandsheets, stabilized dunes, swales, playas, mesatops, plateau parks, alluvial flats, and plains in well-drained, sandy or sandy-loam soils. Sites occur on a variety of aspects and slopes ranging from flat to moderately steep. Annual precipitation is usually from 6-10 inches in the Great Basin. Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by drought-resistant bunch grasses. These grasslands are typically dominated or codominated by Indian ricegrass and/or needle-and-thread grass, James' galleta in the Mojave Desert, and are associated with big sagebrush, shadscale, *Ephedra*, snakeweed, or winterfat.

Value to Wildlife

Wildlife values of grassland and meadow habitats vary significantly among the different ecological systems bundled in this group, and they vary significantly among plant communities within a single ecological system. Stands of ricegrass, needlegrass, and James' galleta occurring within the cold and warm desert scrub landscapes can be quite important to kangaroo mice and kangaroo rats as a primary food source. Sandy soils can be important to burrowing owls.

When these meadows are allowed to build up residual grass materials (such as occurs within a rested pasture), population numbers of montane voles and other rodents will increase, in turn attracting Short-eared Owls that nest on the ground under grassy hummocks. Mule deer and bighorn sheep feed on the forbs in subalpine meadows. The abundant flowering plants characteristic of subalpine meadows are heavily foraged upon by hummingbirds. The mountain pocket gopher is found in the grasslands and meadows of the Sierra Nevada, often along the forest ecotone where loose soils facilitate burrowing.

Key Elements of Grasslands and Meadows Habitat Important to Wildlife

HIGH ELEVATION MEADOWS

TALL FORBS -- foraging, nesting (ground-nesters)

Short-eared Owl
Rufous Hummingbird
mule deer
bighorn sheep
western jumping mouse
dusky shrew

ALPINE-SCREE ECOTONE

American pika
Black Rosy-Finch
Gray-crowned Rosy-Finch

SIERRA NEVADA SPECIFIC

Sierra Nevada snowshoe hare
montane pocket gopher

LOW ELEVATION GRASSLAND

LOOSE SOILS - burrowing

Burrowing Owl

PREY SPECIES - foraging

Prairie Falcon
Ferruginous Hawk
Preble's shrew
pygmy short-horned lizard
greater short-horned lizard

SEMI-DESERT GRASSLAND

SANDY SUBSTRATES - burrowing

Burrowing Owl
pale kangaroo mouse
dark kangaroo mouse
desert kangaroo rat
sidewinder

PREY SPECIES – foraging

Prairie Falcon
Ferruginous Hawk
long-nosed leopard lizard
desert horned lizard

Existing Environment

Land Uses

- Livestock grazing
- Motorized recreation
- Minerals/oil/gas extraction
- Utility rights-of-way
- Road development
- Species Harvest
- Wild horse/burro range

Habitat Conditions

Habitat conditions vary greatly within this key habitat because the plant communities within it are so diverse in their occurrence and character. Upland grasslands are highly variable in occurrence and productivity and dependent on annual precipitation. Ricegrass, needlegrass, and dropseed stands can appear in profusion during wet years and nearly disappear at the same sites during drought years. Ricegrass stands in some areas of western Nevada have recovered in the last 20 years with rest from livestock grazing. Montane and subalpine meadows exist in a variety of conditions depending on management. Meadows in poor condition suffer from soil compaction, erosion, “pedestaling” of vegetation and soils, and lack of residual vegetation that provides critical cover to rodents and nesting birds. As “pedestaling” and erosion advance, water flow increases and accelerates over the meadow, leading to downcutting of the soil base and eventually leading to a significant lowering of the water table, that changes the character, productivity, and site potential of the meadow.

Problems Facing the Species and Habitats

When ungulate utilization exceeds a site’s ability to recover, the result is a reduction of grasses and an increase in shrubs, especially snakeweed and rabbitbrush, therefore affecting species that rely predominantly on the herbaceous condition of these grassland types for sustenance. Lack of residual cover and reduction in seed production reduces site capability to support abundant, diverse rodent populations. Once removed during ore/commodity extraction activities, meadows are practically un-restorable without intense land contouring, restoration of hydrologic regime, and careful tending. Upland grasslands, on the other hand, are relatively successful in reclaiming mine tailings and recontoured mine lands.

Predicted Effects of Climate Change

High Elevation Meadow

LANDFIRE mapping indicated 2,700 acres of high elevation meadow currently exists in the Black Rock Region, 100% in the early stage. A small total of 11 acres registered in the Eastern Sierra region, all of which was predicted to be lost to conversion after 50 years of climate change. The Black Rock acreage was predicted to lose 53% to conversion after 50 years of climate change. Remaining acreage would transition completely out of the early class, equally into the mid-open (28%) and mid-closed (29%) classes, with 44% transition into uncharacteristic classes - 13% transitioning to *Wyethia*-dominant and 44% invaded by silver sage and Woods' rose. The Sierra Nevada community "Northern Pacific Montane Grassland" (2,400 acres) was not evaluated in the TNC report.

Low Elevation Grassland

LANDFIRE mapping indicated 6,900 acres of low elevation grassland in the Black Rock region and 475 in the Elko region. In the Black Rock region, 68% of this BPS occurred in the early class, 30% in the mid-open class and one percent in late-closed. Only one percent occurred in an uncharacteristic class. In the Elko region, 23% of the type occurred in the early class and 77% was tree-encroached. Climate change modeling predicted that significant transitioning away from early- to mid-open (53%) and late-closed (11%) would occur, with 33% transitioning to annual grass and early shrub classes and no increase in tree-encroached. The Elko region acreage was predicted to transition 100% to tree-encroached in 50 years.

Semi-desert Grassland

Semi-desert grasslands occurred in 12 of 13 regions evaluated in the TNC Report. This BPS was reported to be over 90% transitioned into uncharacteristic classes in all regions except Mojave and Tonopah. In both regions the BPS was currently split 50-50 between characteristic and uncharacteristic classes. In the Mojave region, the BPS was predicted to transition 96% to uncharacteristic classes in 50 years with climate change, while in the Toiyabe region 10% more was expected to transition to uncharacteristic after 50 years of climate change for a 60-40 split.

Possible Wildlife Responses to Climate Change

High Elevation Meadow

The primary impact of climate change upon wildlife using high elevation meadow was likely to come from basic loss of acreage to conversion. Mule deer, bighorn sheep, hummingbirds, and American pika foraging on tall forbs would be forced to convert to other forage or ecological systems. All other species would be negatively impacted, but none appeared to be particularly uniquely associated with the habitat type such that its viability in Nevada would be put at-risk by reduction of this BPS alone.

Low Elevation Grassland

Impacts to priority species using low elevation grassland habitats were expected to be impacted somewhat by the transition to rabbitbrush (early shrub) and annual grass. Prairie Falcons and Ferruginous Hawks do not live in the type but would be forced to shift their hunting effort away from these landscapes if prey species diversity and abundance decreased. Burrowing owls demonstrate a tolerance to site disturbance and conversion as long as the general wild nature of the habitat is preserved (i.e., remains undeveloped) and the two short-horned lizard species were not expected to be impacted if ant populations were not significantly changed or reduced. Preble's shrew is the one species that may live in this BPS and be unable to adapt to uncharacteristic class transitions.

Semi-desert Grassland

For all but the Mojave and Tonopah regions, the almost total occurrence of this type in uncharacteristic classes has already caused whatever damage might be expected. The depleted and rabbitbrush classes have the least value to priority species dependent on native grass for food (the two kangaroo mice and desert kangaroo rat). The relative value of the shrub-annual-perennial class is not possible to assess without further knowledge of the relative extent of perennial grasses in the plant community's composition. Regions with over 20% of the BPS in depleted/rabbitbrush classes either now or in 50 years included Calcareous, Elko, Lahontan, Mojave, and Tonopah. Priority predators and insectivores would be expected to shift their foraging effort away from this BPS if prey diversity and/or abundance was reduced significantly. Such a shift was not expected to significantly increase conservation risk for any of the predator guild.

Taking Prescriptive Action

The grassland and meadow communities featured in this chapter were not extensive enough to design prescriptive treatment to avoid the predicted effects of climate change. However, application of best management practices for livestock grazing is important to maintain the ecological integrity of meadows and grasslands.

Priority Research Needs

- Distribution and population status of western jumping mouse
- Comprehensive inventory of shrew species in Nevada
- Habitat relationships model for Preble's shrew

Conservation Strategy

Goal: Thriving self sustaining wildlife populations in healthy plant communities maintained by natural hydrology and periodic fire events, at return intervals sufficient to preclude invasion by shrubs or conifers.

Objective: Maintain high elevation meadows at current distribution and condition through 2022.

Action: Target tall forb meadows for specific wildlife inventory.

Action: Inventory meadows in need of restoration on public and private lands; prioritize restoration list to reflect contribution of site to local wildlife conservation priorities ; develop restoration projects for partnership funding and implement on a priority/opportunity basis.

Action: Develop wildlife objectives and best management practices for montane and subalpine meadows; incorporate into land management planning processes; incorporate into NRCS Nevada WHIP Plan.

Action: Purchase lands from willing sellers or secure easements with willing landowners on critical meadow sites through partnerships and conservation funding.

Objective: Prevent the increase in annual grass and rabbitbrush classes in low elevation grasslands from exceeding 10% in all regions through 2022.

Action: Develop wildlife objectives and best management practices for upland grasslands; incorporate into land management planning processes (listed above).

Action: Inventory low elevation grasslands and their soil site potentials; incorporate native grassland maintenance and restoration objectives to prescribed fire plans and fire rehabilitation plans.

Action: Support maintenance of wild horse and burro populations within Allotment Management Levels (AML).

Objective: Prevent the increase in annual grass and rabbitbrush classes in semi-desert grasslands from exceeding 10% in the Mojave and Tonopah regions through 2022.

Action: Investigate the feasibility of restoring semi-desert grassland habitats to characteristic classes including the restoration of a fire return interval that discourages shrub encroachment applied at very small scales under controlled conditions.

Action: Seed semi-desert grassland sites with native grasses appropriate to the site after fire.

Objective: Maintain mule deer and bighorn sheep populations utilizing high elevation meadows at stable or increasing trend through 2022.

"stable or increasing trend" – as determined by NDOW big game surveys

Action: Monitor high elevation meadows for nutritive content and preferred food forb occurrence.

Objective: Maintain high elevation meadow birds of conservation priority at detectable levels through 2022.

"high elevation meadow birds of conservation priority" – Short-eared Owl; Rufous Hummingbird; Black Rosy-Finch; Gray-crowned Rosy-Finch.

"detectable levels" – as determined by Nevada Bird Count surveys or specialized high-elevation surveys yet to be developed regularly conducted at intervals not to exceed five years.

Action: Evaluate the need to supplement the Nevada Bird Count survey transect network with specifically targeted high elevation meadow transects.

Action: Conduct specific breeding status surveys for Rufous Hummingbird in high elevation meadow habitats.

Objective: Maintain small mammals of conservation priority at detectable levels in high elevation meadow habitats through 2022.

"small mammals of conservation priority" – western jumping mouse, montane pocket gopher, Sierra Nevada snowshoe hare, American pika, dusky shrew.

"detectable levels" – as determined by live trap survey conducted at regular intervals not to exceed five years.

Action: Continue Sierra Nevada snowshoe hare investigations in Nevada.

Action: Add high elevation meadow sites to surveillance live trap survey networks.

Action: Design and conduct a comprehensive inventory of shrew species in Nevada; delineate habitat preferences and species expectation models for all shrews of conservation priority.

Objective: Maintain birds of conservation priority utilizing low elevation and semi-desert grasslands at stable or increasing trend through 2022.

"birds of conservation priority" – Burrowing Owl, Prairie Falcon; Ferruginous Hawk.

"stable or increasing trend" – as measured by NDOW raptor nest surveys conducted at regular intervals not to exceed five years.

Action: Implement a Burrowing Owl survey and inventory that establishes presence/absence on a random survey grid as well as documents specific burrow sites for future reference.

Action: Conduct surveillance aerial surveys for nesting Prairie Falcons and Ferruginous Hawks at regular intervals not to exceed five years.

Objective: Maintain Preble's shrew populations at detectable levels in suitable habitat through 2022.

"detectable levels" – as determined through single-species research or pit trap surveillance surveys conducted at regular intervals not to exceed five years.

Action: Conduct an expanded Preble's shrew distribution and status study across its Nevada range; determine habitat preferences, population connectivity, and conservation risk.

Objective: Maintain pygmy short-horned lizard and greater short-horned lizard populations at detectable levels through 2022.

"*detectable levels" – as measured via specific discovery or status surveys conducted at regular intervals not to exceed five years.*

Action: Continue investigations of distribution and population status of pygmy short-horned lizard and add greater short-horned lizard; determine habitat preferences and impacts of uncharacteristic class transitions on short-horned lizard distribution and population viability.

Objective: Maintain small mammals of conservation priority utilizing semi-desert grasslands at detectable levels through 2022.

"small mammals of conservation priority" – pale kangaroo mouse, dark kangaroo mouse, desert kangaroo rat.

"detectable levels" – as determined by live trap survey conducted at regular intervals not to exceed five years.

Action: Continue studies of kangaroo mice and desert kangaroo rats to delineate habitat preferences and management strategies for each.

Objective: Maintain long-nosed leopard lizard and desert horned lizard populations utilizing semi-desert grasslands at stable or increasing trend through 2022.

"stable or increasing trend" – as measured by surveillance ocular surveys in areas of high commercial collection activity.

Action: Implement a standardized reptile survey in areas of demonstrated high commercial collection activity.

Objective: Maintain sidewinder populations at detectable levels through 2022.

"detectable levels" – as measured by ocular surveys or nocturnal road surveys conducted regularly at intervals not to exceed five years.

Action: Conduct surveillance surveys for sidewinders and other snakes of conservation priority in prioritized habitats and locations.

Action: Implement monitoring for sidewinders and other snakes of conservation priority to determine home range, winter hibernacula, habitat preferences, and responses to vegetative community transitions toward uncharacteristic classes.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	44.5
Private	44.2
U.S. Forest Service	6.2
U.S. Fish & Wildlife Service	2.0
Tribal	1.9
Other	1.2

Existing partnerships, plans, and programs

Multi-partner

- Governor's Sage Grouse Conservation Plan
- Rosachi Ranch restoration project
- Argenta Marsh restoration project

Federal & State Agencies

- Bureau of Land Management
- Natural Resources Conservation Service/Conservation Districts
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- U.S. Bureau of Reclamation
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Agriculture

Conservation Organizations

- National Audubon Society/Lahontan Audubon Society
- Sierra Club
- National Fish & Wildlife Foundation
- The Nature Conservancy

Bird Initiatives

- Partners In Flight
- North American Land Bird Conservation Plan
- Nevada Partners In Flight

Other Key Partners

- Intermountain West Joint Venture
- University of Nevada (UNR, UNLV, Cooperative Extension)
- Sportsman's Organizations

Focal Areas

Adobe Range
Black Rock Range
Carson Sink
East Humboldt Range
Granite Range
Hays Canyon Range
Huntington Valley
Independence Mountains
Independence Valley
Jarbidge Wilderness
Mary's River Drainage
Montana Mountains
Owyhee Desert (South Fork Owyhee drainage)
Pie Creek drainage
Pine Forest Range
Railroad Valley
Ruby Mountains
Ruby Valley
Santa Rosa Range
Sheldon NWR
Shoshone Range
Simpson Park Mountains
Snake Mountains
Spring Valley
Steptoe Valley
Toiyabe Range
Tuscarora Mountains
Upper Reese River Valley
White River Valley

Aspen Woodlands

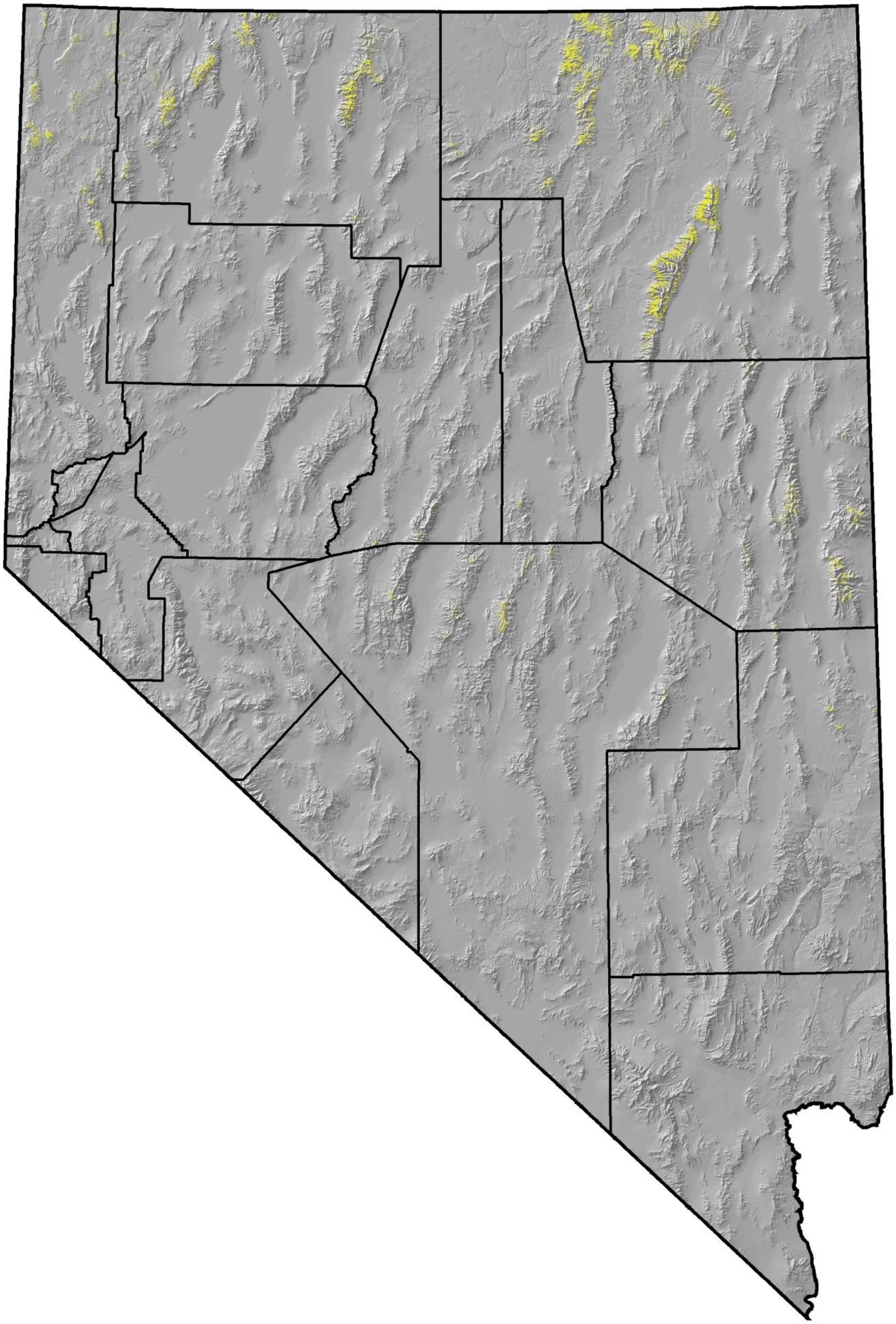


Figure 13. Distribution of Aspen Woodlands in Nevada.

KEY HABITAT: ASPEN WOODLAND

Things to Know….

- Aspen can form extensive stands and is one of the most widely distributed native tree species in North America. In Nevada, aspen is largely restricted to upper elevation riparian zones and high-elevation saturated soils.
- Aspen provides the most important nesting habitat in Nevada for Northern Goshawk.
- Problems contributing to the decline of aspen communities in Nevada include fire suppression, improper livestock grazing, and browsing by big game species.
- A general 10-20 percent loss of aspen statewide due to climate change would reduce the distribution and abundance of priority wildlife species, although not within the next 50 years.
- Prescriptive actions include using prescribed fire, installation of exclosures, and periodic herding of livestock away from stands.

Ecoregions

Southwest ReGAP 2005

Great Basin	150931 hectares	372670 acres
Columbia Plateau	161069 hectares	397700 acres
Mojave	296 hectares	730 acres
Sierra Nevada	1539 hectares	3800 acres

Ecological Systems

TNC Biophysical Settings	*SWReGAP Ecological Systems*
Aspen Woodland ……………………	S023 Rocky Mountain Aspen Forest and Woodland
Aspen-Mixed Conifer…………….	S042 Intermountain West Aspen-Mixed Conifer Forest and Woodland Complex

Key Habitat Description

Aspen is one of the most widely distributed native tree species in North America. In the western United States, aspen communities are established at suitable sites on mountains and high plateaus (Jones, 1985). Aspen can form extensive stands or its distribution may be more limited and expressed as riparian stringers or disjunct patches. In the higher reaches of riparian drainages, aspen may occur in dense stands of smaller-stature trees on side slopes and snowpocket areas (Dobkin et al., 1995). In Nevada, extensive aspen communities are found in the Snake, Schell Creek, White Pine, Jarbidge, Independence, and Monitor Ranges, as well as the Santa Rosa and Ruby Mountains (Neel, 1999). Scattered stands of aspen occur as far south as the Spring Mountains near Las Vegas and in the adjacent Sheep Range (Lanner, 1984). Aspen rarely grows from seed because of its demanding seed bed requirements and high vulnerability to herbivory, and aspen clones present today have likely maintained their presence on those sites for thousands of years through vegetative regeneration. The presence of aspen indicates a long history of disturbance, primarily frequent fires. Given these characteristics, aspen condition is an excellent indicator of ecological integrity (Kay, 1997a).

Within Nevada, aspen generally occupies elevations between 6,000 and 8,000 feet (Lanner, 1984). Aspen communities are found on all aspects and grow where soil moisture is not a limiting factor. Climatic conditions vary greatly over the range which aspen occupies in the western United States, but most aspen areas receive at least 38 centimeters of precipitation per year (Jones and Debyle, 1985). Aspen is typically shade intolerant and commonly grows in even-aged stands; however, multi-aged stands are more common than expected. Climax aspen communities which persist at a site for several centuries without appreciable change occur throughout the West. When found in association with coniferous species other than pinyon or juniper, aspen communities may progress toward conifer dominance or replacement in the absence of disturbance. Grasslands and shrublands may also replace aspen communities on sites not suited for the establishment and growth of conifers (Mueggler, 1985). “Firebreak” is a common term used to describe aspen because of its difficulty to burn and tendency to diminish crown fires spreading from adjacent conifer stands. Aspen only readily burns in early spring or late fall, when the trees are leafless and understory plants are dry (Kay, 1997b). Aspen communities can be multi-layered. When present, tall shrubs form an open and intermittent layer from six to 12 feet. Shorter shrubs and tall herbs frequently form a more continuous layer at about three feet. Shrubs common in aspen stands in Nevada include snowberry and currant. Common forbs in aspen understory include meadow-rue, yarrow, columbine, lupine, and larkspur (Neel, 1999).

Value to Wildlife

Aspen communities have exceedingly high biodiversity, second only to riparian areas on western ranges (Kay, 1997b). Aspen produce forage for both wildlife and domestic livestock. Healthy aspen communities consist of developed dense multi-age structure that provides benefits to wildlife dependent upon the diverse nature of these communities. Aspen communities are particularly important to cavity nesting species in Nevada because stems attain sizes over 10 inches diameter and the wood is soft and easy to excavate. Because large diameter aspen tend to occur less often in snow pocket aspen communities, riparian aspen stands tend to be preferred by cavity nesting species (Dobkin et al*.*, 1995). In addition to cavities and peeling bark, mature aspen communities provide larger diameter trees utilized by wildlife as forage substrate or nesting. For example, Northern Goshawks can live in and utilize high-elevation shrub-steppe habitats because stringers of large-diameter aspen trees with closed canopies in the riparian zones will support their nesting needs (Younk and Bechard, 1994). Birds and small mammals utilize mid-story structure and herbaceous/shrub understory of aspen communities for forage, nesting, and protective cover.

Downed trees in aspen habitat can create slow moving water conditions favorable to Columbia spotted frogs. In northeastern Nevada, some thriving Columbia spotted frog populations are associated with aspen stands with these types of conditions (personal communication, Genny Wilson, Forest Wildlife Biologist, Humboldt-Toiyabe National Forest, June 2005). In addition to its value to wildlife, aspen has a fundamental scenic value and local human communities benefit economically from the associated tourism.

Key Elements of Aspen Woodland Habitat Important to Wildlife

MATURE OVERSTORY – nesting structure (large stems), foraging, roosting, escape cover

Northern Goshawk

MIXED ASPEN-CONIFER – nesting structure, foraging, protection from predators

Flammulated Owl
Cassin’s Finch
silver-haired bat

hoary bat

SHRUB AND HERBACEOUS COVER – nesting structure, foraging, protection from predators, thermal cover

Dusky Grouse
Sooty Grouse
Mountain Quail
Rufous Hummingbird
Inyo shrew
Merriam's shrew
montane shrew
western jumping mouse
mule deer

CAVITIES/PEELING BARK – nesting, roosting, foraging (insect prey base in dying trees)

Lewis's Woodpecker
fringed myotis
little brown myotis
long-eared myotis
western small-footed myotis

DOWNED WOOD – creates favorable conditions for Columbia spotted frogs (slow moving water) as well as stores ground moisture and maintains mesic microsites (northern rubber boa).

Columbia spotted frog
northern rubber boa

Existing Environment

Land Uses

- Livestock grazing
- Recreation - camping
- Spring development
- Mineral exploration
- Species harvest

Habitat Conditions

Native Americans managed the landscape for at least 12,000 years prior to European settlement and utilized prescribed fire extensively. The resultant higher frequency low intensity fires contributed to the presence and condition of aspen today (Kay, 1997b). Aspen has declined 60 to 90% throughout the West and in Nevada. Many aspen stands containing old-age or single-age trees have not successfully regenerated for 80 years or longer (Kay, 1997b; Kay and Bartos, 2000). The decline of aspen communities has been largely attributed to declines in natural disturbances (e.g., fire suppression in the surrounding landscape) and increases in ungulate herbivores. Aspen communities that have been burned by wildfire or prescribed fire often fail to regenerate because regeneration is impeded by excessive browsing, resultantly, many aspen stands in Nevada are dominated by old-age or single-age trees (Kay, 1997b).

The Humboldt-Toiyabe National Forest has management responsibility for most aspen occurring in Nevada, and the condition of the aspen communities on Forest lands range from very poor to good. Some aspen clones have been reduced to a single tree or are no longer present on the landscape, particularly at lower elevations. Aspen is considered by some to be among the most imperiled terrestrial habitats in Nevada and is a priority in the current Humboldt-Toiyabe Forest Plan revision.

Problems Facing the Species and Habitats

Problems contributing to the decline of aspen communities in Nevada include fire suppression, improper livestock grazing, and browsing by big game species. Aspen survival is enhanced by periodic disturbance events such as fire or logging which stimulates vegetative regeneration through root suckering and reduces conifer competition. Conifer encroachment is a problem for aspen communities in Nevada, particularly in the Sierra Nevada, Schell Creek, and Snake ranges, and could eventually result in the elimination of aspen clones in these areas if disturbance is not allowed to occur or is not introduced into these communities. Livestock and wild ungulate grazing alter vegetation structure and contribute to the declining condition of aspen communities. Livestock and wild ungulates consume different types of forage that are available in aspen communities. Utilization by wild ungulates tends to reduce shrubs and tall palatable forbs while favoring the growth of native grasses in aspen communities, while livestock grazing tends to reduce native grasses and promote introduced species and bare soil (Kay and Bartos, 2000). If the aspen clone is lost due to forest succession or other factors that lead to a dewatering of the site, there are no known means of aspen clone reestablishment (Kay et al*.,* 1994). Although aspen can withstand moderate levels of grazing by livestock and wild ungulates, caution should be taken in efforts to restore aspen through prescribed burning because burning plus repeated browsing hastens the elimination of aspen clones that have weakened root reserves (Kay, 1997b).

Aspen communities in riparian areas provide many recreational and commercial uses in Nevada (Neel, 1999). People are drawn to aspen stands for camping which contributes to soil compaction and potential disturbance to wildlife. In northeastern Nevada, gold exploration in aspen communities is widespread. Directional drilling and scheduling exploration activities outside of critical wildlife seasons (e.g., nesting) can reduce some of the potential effects of mineral exploration, but complete habitat loss may occur if an aspen community is mined for gold. Spring development within and upslope of aspen woodlands is also a concern for aspen communities because of their need for the water. "Natural" problems for wildlife in aspen communities include resource competition and global climate change. Nest site availability (i.e., cavities) and competition with other individuals may limit wildlife in aspen communities (Dobkin et al*.,* 1995). Lastly, global climate change may affect aspen communities by reducing the recharge of soil with snowmelt water during the spring (DeByle, 1985). The results of modeling climate change effects on aspen habitats in Nevada are presented in the following section.

Predicted Effects of Climate Change

Aspen-Mixed Conifer

Currently the aspen-mixed conifer BPS occurs primarily in the Black Rock, Elko, and Calcareous regions. In reference condition, the type should be distributed ~20% in the early class, ~70% in two mid-closed classes, and ~10% in the late classes. Current conditions varied widely among the three principal regions – Black Rock registered 62% in the early class; nine percent in the mid-closed classes, and 28% in the late classes; Calcareous registered 10% in the early classes, 10% in the mid-closed classes, 80% in the late classes; Elko registered 100% in late classes (Appendix C).

Modeled succession in the Black Rock tracked predictably – the bulk of early aspen transitioning to mid-closed, mid-closed to late, and late back to early but with 12% acreage loss during this particular transition attributed to conifer encroachment, sagebrush encroachment, and excessive herbivory at the nascent A stage. In the Calcareous, late classes transitioned through the early stage into mid-closed in 50 years, mid-closed and late-open transitioned into late-closed, but there was a 20% loss of acreage in the late to early transition (same conversion processes as Black Rock). In the Elko region, roughly 20% of late classes transitioned into early and mid-closed classes in roughly equal proportions and a little (<5%) actually reached late-closed, but over 50% of the type stayed in the late-open class and 16% of it was lost in the transition back to the early class (same three processes again).

Aspen Woodland

The aspen woodland BPS occurs in 12 of the 13 evaluated regions, totally absent in only the Mojave, but present in the Walker Corridor as 11 acres. Currently, aspen woodland in the northern and eastern regions is heavily weighted in very late successional stages (late-open and depleted), ranging from 44% (Eureka) to 93% (Clover). The western regions (Eastern Sierra, Lahontan, Walker, Toiyabe, and Tonopah) are in much healthier condition, weighted heavily in the early closed (unfenced) class (Appendix C).

Modeled succession in the northern and eastern regions tracks toward an apparent return to conditions closer to reference, but the better distribution of classes comes at a high price – loss aspen acreage from vulnerable classes (late-succession and early-succession classes) ranging anywhere from eight (Elko) to 31% (Clover). A predicted "gain" of 21% in the Owyhee region is an anomaly of modeling precision. Succession in the western regions is predicted to occur more naturally with less aspen loss – ranging from three (Tonopah) to 19% (Lahontan), but the Walker Corridor is predicted to lose all 11 acres of its aspen woodland in 50 years with climate change. Generally speaking, all regions will be transitioning into healthier stand conditions favorable to wildlife, but valuable clones will be lost to other ecological systems (for example, mixed conifers and montane sagebrush steppe) in the transition, resulting in a net reduction in available acres of aspen woodland habitat.

Possible Wildlife Responses to Climate Change

Northern Goshawk

In high-elevation shrub steppe habitats of the Great Basin, Northern Goshawks are able to occupy the landscape by nesting in small, widely-scattered stands of mature aspen trees that grow along creeks and drainages. Younk and Bechard (1994) characterized goshawk nesting stands as primarily located on north or east-facing slopes, and described the canopy as mostly closed with open understory of very little cover. Their results appear focused on aspen woodlands more than aspen-mixed conifers, which usually do not support an open understory when encroached by dense mixed conifers in older stands. They reported average nest tree age at 60 years. Understory cover is usually reduced by livestock that use the stands for grazing and shading during the hot summer months. This description would fit the late-closed and late-open states of aspen woodland and, by extension, known conifer use by goshawk elsewhere, to the mid-closed, late-open, and late-closed states of aspen-mixed conifer.

The relation between the future, predicted dynamics of both aspen types and goshawk nesting needs is nuanced at three levels.

- For aspen woodlands, aging of the canopy from closed to depleted might allow a nesting goshawk to persist in the stand, but generally this would be considered a toleration of sub-ideal conditions.

Abandonment could be predicted as stand vigor continued to deteriorate towards permanent conversion to sagebrush steppe.

- For aspen-mixed conifer stands, aging stands that become dominated by mixed conifers, and then convert entirely to mixed conifer, can benefit goshawk because the species is known to use, even prefer, conifer-dominated forests and woodlands elsewhere in the Intermountain West.

- Eventually, aspen stands will burn or be attacked by diseases and insects. Fire activity imported from the surrounding landscape is likely to increase with climate change to the increasing cover of cheatgrass in the adjacent sagebrush steppe BPS. As modeling results indicated significant turnover of these late-succession stands into their regenerative stages, the future for Northern Goshawk nesting pairs on the Great Basin landscape is expected to be very much in a state of flux over the next 50 years. The challenge for managers will be to maintain enough late-succession stands on the landscape (particularly in the Elko region where the heart of the Northern Goshawk nesting population has resided over the last 40 years) to facilitate goshawk nesting needs through the transition such that significant population shift away from the shrub steppe landscape is minimized. It will be very difficult to restore declining aspen stands as long as a nesting pair persists in it, practically necessitating the wait for a pair to shift away from a stand before applying treatment, which in turn may conflict with a "healthy ecosystem" approach to land management. An evaluation of Younk and Bechard's nest occupancy data suggests a 10% occupancy rate among available nests. This also corroborates with NDOW's latest goshawk survey information (NDOW, 2010). A 10% occupancy rate may allow managers the flexibility they need to manage aspen stand health and regeneration across broader landscapes.

More Mature Overstory and Mixed Conifer

Several Species of Conservation Priority are associated with aspen-mixed conifer including Flammulated Owl, Cassin's Finch, silver-haired bat, and hoary bat. Like Northern Goshawks, Flammulated Owls are associated with large-dbh conifers in other parts of their range (goshawks – closed-canopy mixed conifer; Flammulated Owls – ponderosa/Jeffery pine), but in the Great Basin, they stretch their habitat use somewhat to include aspen-mixed conifer, and it appears some occurrence of mixed conifer is rather important to occupancy (Mika and Riddle 2007). Cassin's Finches are crown nesters found in various associations of mixed conifer, aspen, and pinyon-juniper and feed on the seeds and catkins of the trees found in all three types. They are expected to primarily nest in the three late-succession classes of aspen-mixed conifer, while utilizing the two early stages for foraging. NDOW research has documented significant use of aspen-mixed conifer in the Jarbidge (Elko Region) area, where their use of open-top snags for community roosts was determined by radio telemetry (NDOW 2010). Hoary bats are known to migrate through the area, using aspen-mixed conifer habitat among others, but if they spend any significant time in these Nevada habitats as part of their annual life cycle, it has yet to be ascertained. Snag preferences of the Flammulated Owl and the bats would suggest affinities for the late-open and late-closed classes. Other SOCP's expected to use the type in its late-succession classes include fringed myotis, little brown myotis, long-eared myotis, and western small-footed myotis.

Lewis's Woodpeckers are well-known as fire-facilitated conifer birds, but their use of aspen woodlands in the Great Basin and other Intermountain West shrubsteppe is only now beginning to be studied and understood. Here, Lewis's Woodpeckers are not necessarily fire-facilitated; rather, they use aspen woodland as a surrogate for burned conifer that allow them to populate the greater shrubsteppe landscape, much like Northern Goshawk and Flammulated Owl (Newlon and Saab 2011). Their need for cavities to nest in is facilitated by aspen's soft wood particularly when it is infected by heart rot, and a robust understory is generally considered to positively support this woodpecker's insect-hawking feeding strategy through greater abundance of flying arthropods.

The GBBO Report indicated that 38% of the computed statewide "population estimate" of Lewis's Woodpeckers based on Nevada Bird Count survey observations would occur in the late-open aspen woodland class, followed by 15% occurring in the early aspen Woodland class. This corroborates a perception of the Lewis's Woodpecker as a denizen of old growth aspen (>99 years old) with soft heartwood and snags on the cusp of transitioning back to early as well as a colonizer of early aspen Woodland stands (most likely as per fire event). In over 200 points surveyed over a 10-year span, Lewis's Woodpecker was never observed in aspen-mixed conifer during Nevada Bird Count surveys.

Shrub Mid-story and Herbaceous Understory

Several Species of Conservation Priority are associated with aspen types because the mesic environment is also conducive for lush growth of montane shrubs, grasses and flowering forbs. Several important game species, including mule deer, Dusky and Sooty Grouse, and Mountain Quail, feed on the leaves, new stems, and fruits of mountain snowberry, gooseberry, and other associated montane shrubs. The three SOCP shrews rely on thick understory not only for their own protective cover but for the provision of diverse, abundant arthropod populations for food. Western jumping mice are associated with tall, ungrazed grasses such as are seasonally found on mesic aspen sites and migrating Rufous Hummingbirds replenish their carbohydrate loads on the nectar of flowering forbs also found in the mesic understory. These species' life history support is enhanced by the judicious application of grazing strategies that allow for understory growth, maturation, and reproduction prior to turn-in, and they are expected to use all aspen woodland and aspen-mixed conifer classes except depleted. Northern rubber boas and Columbia spotted frogs depend on the maintenance of the mesic character of the aspen site, which implies dense aspen canopy cover. Down woody material, shrub and herbaceous litter, and shade all work to retain moisture on the site and maintain the wetness of mesic microsites that serve these species' thermic requirements. Loss of aspen through mismanagement of a site that causes it to lose its clone and mesic character will result in the disappearance of these species from the larger landscape.

The predictions of the climate change analysis suggest that the transition of aspen in the northern and eastern regions from late succession to early succession classes might create episodic challenges for late-successional wildlife species that require cavities (Lewis's Woodpecker), closed canopies (Northern Goshawk), and snags (bats) for shelter and nest substrate. Conversely, in the western regions, transitioning from predominant early stages to later-successional stages would suggest improving habitat conditions for the same species. Monitoring might reveal a shift of highly-mobile species such as birds and bats in a general westward or southwestward direction. Of greater concern, however, is the predicted conversion of aspen to non-aspen types and loss of the clones which would make restoration to aspen particularly difficult. A general 10-20% loss of aspen statewide would reduce the distribution and abundance of the SOCP's featured in this discussion, although we expect none of them to disappear from the state in at least the first 50 years.

Prescriptive Actions

For information on recommended prescriptive actions, see Appendix C.

Priority Research and Monitoring Needs

- Spatial distribution of aspen woodlands across the pre-settlement and current landscape in Nevada.

- A statewide health assessment of aspen stands and a systematic, prioritized strategy for restoration that optimizes resources and maximizes success.
- Proper rest intervals for aspen woodlands after natural disturbance or treatment.
- Individual levels of use and effects of livestock and big game in aspen communities to aid in the management of grazing allotments containing aspen communities.
- Goshawk territory models for aspen that accurately represent territory size, habitat composition and quality, alternate nest site potential, and prey base availability and productivity.
- Responses of Northern Goshawks to treatments promoting aspen regeneration and restoration across the landscape, including habitat use, nest site selection, and population demographics.
- Monitor anticipated shifts in bird and bat populations southward and westward if aspen transitions proceed as predicted.

Conservation Strategy

Goal: Thriving wildlife populations in self-sustaining, multiage aspen communities with structural complexity that provides wildlife needs.

Objective: Manage aspen woodlands and aspen-mixed conifer not to exceed 10% loss to type conversion through 2022.

Action: Assess condition of aspen woodlands in Nevada using Resource Implementation Protocol for Rapid Assessment Matrices (Humboldt-Toiyabe National Forest) or other approved protocol.

Action: Identify and prioritize aspen woodlands for restoration through management treatment(s) including prescribed fire and conifer removal.

Action: Support and conduct identified primary research needs and incorporate results in the development of the following management and conservation actions.

Action: Implement prescribed burning and/or silviculture treatments at appropriate temporal and spatial scales.

Action: In small patch aspen communities, protect recently treated (burned or logged) regenerating aspen saplings with stand exclosures.

Action: Manage grazing in aspen communities to allow for a diverse grass understory and aspen regeneration.

Action: Manage big game in aspen communities to allow for a diverse, healthy shrub and forb community and aspen regeneration.

Action: Maintain ground cover with only small bare soil openings to maintain adequate water infiltration and prevent undue erosion from intense storms.

Action: Provide public outreach through signing or other appropriate means that increases public awareness of the effects of camping in aspen stands on wildlife and their habitat.

Action: Minimize the effects of mineral exploration on aspen and wildlife communities through measures such as directional drilling or seasonal restrictions.

Action: Avoid spring development in and directly above aspen woodlands that withdraws water beyond sustainable levels.

Objective: For functional wildlife habitat, manage aspen woodland and aspen-mixed conifer stands to approximate 30-50% in mid- or late-successional stages with 20-30% in regenerating early stages through 2022.

Action: Protect known Northern Goshawk nesting territories from the reduction of structural complexity or complete habitat loss. Develop aspen regeneration strategies at the landscape scale with consideration for the preservation of active northern goshawk territories in project design and implementation.

Action: Identify and prioritize aspen woodlands where mesic microsite maintenance could improve habitat conditions for Columbia spotted frogs through impediment of water flow, retention of down woody material, etc.

Action: Implement cooperative conservation strategies for Columbia spotted frog in the Toiyabe Range and northeast Nevada as identified in the Columbia Spotted Frog Conservation Agreements and Strategies.

Objective: Stabilize a declining trend in Northern Goshawk nest site occupancy by 2022.

"stabilize" – halt the decline to "no further loss"; "declining trend" – recent surveys have revealed significant reductions in nest site occupancy since 1995, particularly in Elko County (NDOW 2011).

Action: Reinitiate annual Northern Goshawk nest monitoring statewide to compute a current statewide nest site occupancy rate and breeding pair estimate to inform aspen management strategies as well as discussion of issues related to falconry take.

Action: Initiate nesting habitat investigations to determine cause of Northern Goshawk nest site vacancies in key portions of breeding range.

Action: Monitor aspen wildlife communities through statewide partner networks, such as The Nevada Bird Count, to assess the degree and extent of shift from aspen regions transitioning from into less suitable conditions to aspen regions transitioning to more favorable conditions.

Objective: Maintain Flammulated Owl populations at detectable levels in suitable habitats through 2022.

"detectable levels" – as determined by taped call surveys conducted at regular intervals not to exceed five years.

Action: Continue to monitor Flammulated Owl occupancy in historic sites while regularly surveying new potential habitats until statewide range and distribution is well-delineated.

Action: Investigate the relative importance of mixed conifer in aspen habitats for Flammulated Owl occupancy and adjust management strategies accordingly.

Action: Participate in regional Flammulated Owl survey efforts as coordinated through the Western Working Group of Partners In Flight.

Objective: Maintain Lewis's Woodpecker at stable trend through 2022.

"stable trend" – as determined by USGS Breeding Bird Survey or Nevada Bird Count results.

Action: Conduct an analysis on current aspen bird survey transects to determine if sample size should be increased by adding new transects.

Action: Update Lewis's Woodpecker habitat suitability model through updated literature review or field collection of habitat suitability data.

Action: Monitor fire-related movements of Lewis's Woodpecker between aspen stands and regions.

Objective: Maintain other birds of conservation priority at stable or increasing trends in aspen habitats through 2022.

"other birds of conservation priority… in aspen" – Cassin's Finch; Dusky Grouse; Sooty Grouse; Mountain Quail; Rufous Hummingbird

Action: Encourage aspen stand management strategies that preserve vigorous montane shrub and herbaceous understories through critical periods in the life history cycles of grouse and Mountain Quail (e.g. nesting, early brooding).

Action: Survey for possible Rufous Hummingbird breeding activity in the Jarbidge Mountains, Ruby Mountains, Snake Range and Santa Rosa Mountains in aspen stands near alpine/subalpine habitats.

Objective: Maintain bats of conservation priority at detectable levels in aspen habitats through 2022.

"bats of conservation priority… in aspen" – silver-haired bat; hoary bat; fringed myotis; little brown myotis; long-eared myotis; western small-footed myotis

"detectable levels" – as determined by acoustic or net survey conducted regularly at intervals not to exceed five years

Action: Maintain standing snags and old age-class trees in aspen woodlands and aspen-mixed conifer habitats.

Objective: Maintain small mammals of conservation priority at detectable levels in aspen habitats through 2022.

"small mammals of conservation priority… in aspen" – Inyo shrew; Merriam's shrew; montane shrew; western jumping mouse

"detectable levels" – as determined by live trap or pit trap survey conducted at regular intervals not to exceed five years

Action: Include aspen habitat sites in a comprehensive statewide shrew population and distribution status assessment to develop baseline knowledge of priority species distributions and relative abundance.

Action: Conduct species population status and habitat suitability studies for western jumping mouse.

Objective: Maintain reptiles and amphibians of conservation priority at detectable levels in aspen habitats through 2022.

"reptiles and amphibians of conservation priority… in aspen" – northern rubber boa; Columbia spotted frog

"detectable levels" – as determined by pit trap or ocular survey conducted at regular intervals not to exceed five years

Action: Support aspen management strategies that encourage ground coverage and litter buildup in shaded saturated/semi-saturated soil zones.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
U.S. Forest Service	63
Bureau of Land Management	20
Private	12
National Park Service	2
Tribal	2
U.S. Fish & Wildlife Service	<2
Other	<1

Existing partnerships, plans, and programs

Federal & State Agencies
- U. S. Forest Service
- Bureau of Land Management
- National Park Service (Great Basin National Park)
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Agriculture
- Nevada Natural Heritage Program

Conservation Initiatives
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners in Flight
- Nevada Bat Conservation Plan

Sportsmen's Organizations
- Mule Deer Foundation
- Rocky Mountain Elk Foundation

Conservation Organizations
- The Nature Conservancy
- National Audubon Society/Lahontan Audubon Society

Other Key Partners
- Eastern Nevada Landscape Coalition
- Counties
- Native American Tribes
- University of Nevada
- Mining Industry/Nevada Mining Association
- Great Basin Bird Observatory
- Intermountain West Joint Venture

Focal Areas

Black Rock Range
Boulder Mountain
East Humboldt Range
Granite Range
Hays Canyon Range
Independence Mountains
Jarbidge Wilderness
Pine Forest Range
Ruby Mountains
Santa Rosa Range
Sheldon NWR
Snake Mountains
Snake Range
Toiyabe Range
Tuscarora Mountains

Alpine & Tundra

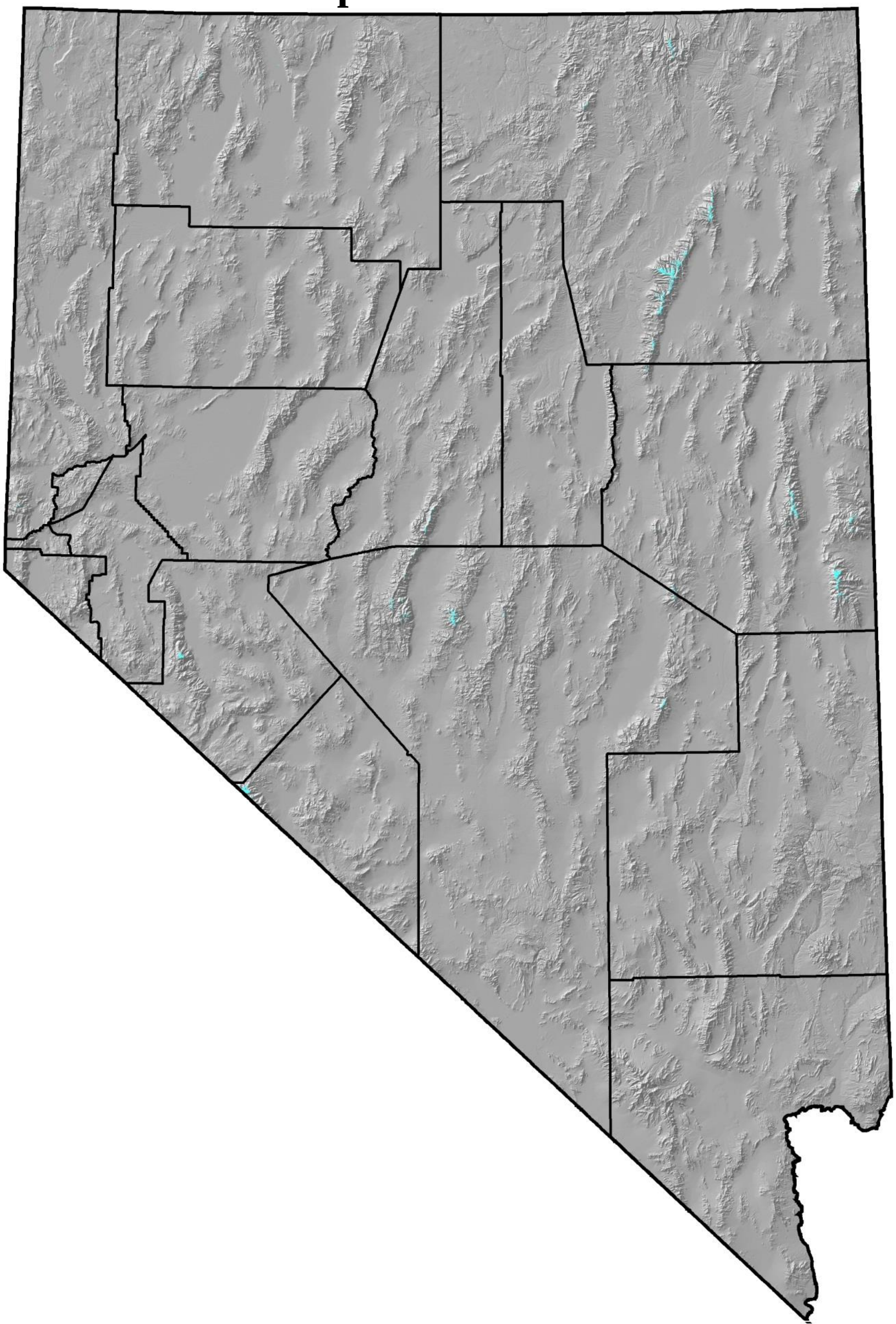


Figure 14: Distribution of Alpine and Tundra in Nevada.

KEY HABITAT: ALPINE AND TUNDRA

Things to Know….

- Alpine and tundra habitats are found at elevations above 10,600 feet.
- Key priority species include American pika, Black Rosy-Finch and Gray-crowned Rosy-Finch. Key features include snowmelt margins, talus slopes, and cool summer temperatures.
- Habitat threats include climate change, recreation, and development resulting in habitat fragmentation and loss.
- Climate change effects analyses have projected a 22% loss within the Elko region with other regions difficult to assess due to small acreages of alpine and tundra.
- No prescriptive actions were developed for this habitat.

Ecoregions

Southwest ReGAP 2005

Great Basin	18,055 hectares	44,613 acres
Columbia Plateau	912 hectares	2,253 acres
Sierra Nevada	118 hectares	291 acres
Mojave	small patches (unmapped)	
Total	19,085 hectares	47,157 acres

LANDFIRE 1211440 Rocky Mountain Alpine Turf (TNC Alpine) – Presented separately because this is the only primarily vegetated community in the aggregation of habitats represented by the SWReGAP ecological systems below.

Great Basin	699 hectares	1725 acres
Columbia Plateau	-	-
Mojave	-	-
Sierra Nevada	79 hectares	196 acres
Total	778 hectares	1921 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
	S002 Rocky Mountain Alpine Bedrock and Scree
	S003 Mediterranean California Alpine Bedrock & Scree
Alpine…………………………………	S081 Rocky Mountain Dry Tundra

Key Habitat Description

Alpine and tundra habitat is restricted to the highest elevations in Nevada and ranges from 3,500 to 4,005 meters (10,600 to 13,140 feet). The alpine ecological systems are composed of barren and sparsely vegetated substrates which typically include both bedrock outcrop and scree slopes with nonvascular plant-dominated communities. Alpine habitats are exposed to desiccating winds, rocky and sometimes unstable substrates, and plant growth is limited by a short growing season. Thin biological crusts which cover the ground surface are a common feature of pristine areas in alpine tundra which are composed of varying proportions of lichens, mosses, cyanobacteria, and fungi, depending upon the environment and degree of crust development. These "cryptogamic" crusts vary in thickness from just a few millimeters to more than a few centimeters, and enhance the nutrient status of the soil, retard erosion by wind and water, help retain soil moisture, and enhance seedling establishment. Forbs, grasses, lichens, and low shrubs are sparsely distributed in alpine habitats. Dominant herbaceous species include shrubby cinquefoil, tufted hairgrass, Shasta sedge, spring sedge, alpine timothy, alpine avens, and cushion phlox.

Rocky Mountain dry tundra occurs on gentle to moderate slopes, flat ridges, valleys, and basins, where the soil has become relatively stabilized and the water supply is more or less constant. Snow retention, wind desiccation, permafrost, and a short growing season influence vegetation in these areas. A dense cover of low-growing, perennial grasses and forbs characterize these tundra habitats. Rhizomatous, sod-forming sedges are the dominant grasses, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs (NatureServe, 2004).

Value to Wildlife

Seeds, insects, and emergent vegetation are important food sources for wildlife in alpine and tundra habitats. In addition, special features of these habitats provide wildlife foraging microhabitats for resident and migratory species. For example, Black Rosy Finches forage on snowfield surfaces and on wet soil and meadow edges of snowbanks, where receding snow drops insects and seeds and uncovers other previously concealed food items. Black Rosy Finches concentrate foraging activity in snow patches, rocky meadows, and fell fields with some occasional use of shrubs, trees, and grassy meadows. In the winter, Black Rosy Finches feed in alpine tundra habitats during fair weather when the ground is blown free of snow (Johnson, 2002). Another alpine species, Gray-crowned Rosy Finch, usually forages on open ground, among rocks on talus, and on open snow fields and glaciers in alpine habitats (MacDougall-Shackleton et al., 2000).

Alpine and tundra habitats are valuable to wildlife seeking special features such as wet areas on the tundra, talus slopes, or animal prey. Some mammal species that occur in these habitats have limited to no capability of dispersal between mountain ranges because of the isolating nature of the intervening valleys. As a result, these populations may be genetically unique and specially adapted to local conditions.

Key Elements of Alpine and Tundra Habitat Important to Wildlife

CONIFER ECOTONE – foraging, protection from predators and nesting (edge conditions resulting in denser cover)

Dusky Grouse
Sooty Grouse

FORAGING – food sources include seeds, insects, and emergent vegetation

Black Rosy-Finch
Gray-crowned Rosy-Finch
Rufous Hummingbird
bighorn sheep
mule deer
dusky shrew

TALUS SLOPES – foraging, protection from predators, thermal cover
American pika

PREY POPULATIONS – feeding on species in this habitat
Golden Eagle
Prairie Falcon

Existing Environment

Land Uses

- Motorized recreation – OHVs, snowmobiles
- Non-motorized recreation – hiking, skiing, snowboarding
- Recreation development – ski areas
- Livestock grazing
- Communication sites
- Wind energy development

Habitat Conditions

Alpine and tundra communities have been receding during the warm and dry conditions of the last 10,000 years. Since the passage of the Nevada Wilderness Protection Act of 1989, many alpine and tundra areas have received special designations that restrict certain uses and this largely benefits alpine and tundra habitats and wildlife species. Due to their remoteness and difficulty of access, alpine and tundra habitats in Nevada are generally in good condition.

Problems Facing the Species and Habitats

Global climate change and recreation have been identified as the primary problems facing alpine and tundra communities in Nevada (personal communication, Humboldt-Toiyabe National Forest personnel, December 2004). Warmer temperatures resulting from climate change may have long-term impacts on alpine habitats and their species through the fragmentation and loss of habitat. Many high elevation habitats in Nevada are within established Wilderness Areas or other undeveloped areas where non-motorized recreation is the most common use. OHV use is typically concentrated at the lower elevations but incursion of OHVs and snowmobiles into alpine areas can disturb wildlife or damage alpine vegetation, which is slow to recover. Ski area development and operation has localized effects on alpine habitat and the associated species in the Carson Range and Spring Mountains. Development of communication sites on mountain tops results in habitat loss, fragmentation, and disturbance to wildlife. Bighorn sheep using alpine and tundra sites are vulnerable to diseases carried by domestic sheep if contact between the two is made.

Predicted Effects of Climate Change

Alpine vegetation was mapped by LANDFIRE and evaluated by the TNC climate change analysis but acreages were very small. Two regions – Eastern Sierra and Elko – registered acreages large enough to analyze. This does not mean that alpine is absent elsewhere; the south Snake Range in the calcareous region harbors alpine vegetation but LANDFIRE appears to have classified alpine as “barren.” Reference conditions for the biophysical setting are one percent early and 99% late-closed. A total of 143 acres in the Eastern Sierra was classified 100% late-closed, basically reference condition. A total of 818 acres was inventoried in the Elko region, 60% of which was classified in the early stage, 40% in the late-closed stage. With 50 years of climate change, the Elko region was modeled to transition to 90% late-closed with a 22% loss to conversion. In the Eastern Sierra, conditions were modeled to remain unchanged and a 46% *increase* in acreage was predicted; therefore, this result was treated as an anomaly of working with very small acreages within the modeling technique.

Possible Wildlife Responses to Climate Change

Transitioning from one class to another was not expected to negatively impact any priority species dependent on alpine vegetation, but a 22% loss, if validated, would likely result in negative responses by American pika which would suffer resource loss and loss of living space. Because the acreages are so small and the directional trends were conflicting between the two regions, definitive statements about the fate of the alpine vegetation type should be avoided.

Taking Prescriptive Action

No prescriptive management was designed for alpine vegetation. Although restoration techniques for disturbed sites do exist (*Krautzer and Wittmann, 2006*), if environmental conditions are significantly altered by climate change to the point that alpine communities can no longer persist on a site, the wisdom of attempting restoration through conventional agronomy would have to be intensely scrutinized. Other than unmanageable air temperature, the next greatest transformation of the alpine is encroachment by subalpine conifers as thermal conditions improve for trees (Salzer et al., 2009). Therefore, chainsaw removal of young trees is, theoretically, a method to preserve the alpine.

Priority Research Needs

- Long-term responses of alpine and tundra communities to global climate change.
- Wildlife species that measurably respond to stresses in alpine and tundra habitats (e.g., Gray-crowned Rosy-Finch, Black Rosy-Finch, American pika).
- Effects of recreation on alpine and tundra vegetation and wildlife species.
- Minimum viable population size of disjunct populations of Species of Conservation Priority in alpine and tundra habitats (e.g., bighorn sheep, American pika).
- Population demographics of American pikas and model viability of individual populations.
- Factors contributing to American pika extirpation in Nevada that partition natural variability more clearly from anthropogenic influence (Beever et al*.,* 2003)
- Refined population trend estimates and factors determining population status of Black Rosy-Finches.

Conservation Strategy

Goal: Thriving self-sustaining wildlife populations in environmentally resilient alpine and tundra habitats that remain intact while supporting human uses.

Objective: Prevent the loss of the alpine BpS from exceeding five % in all regions through 2022.

Action: Design and implement priority research projects to facilitate the development of effective conservation and management guidelines for alpine and tundra habitats.

Action: Implement guidelines for recreation in alpine and tundra habitats that prevent damage to vegetation and biological crusts and minimize wildlife disturbance during crucial seasons (i.e., nesting, migration).

Action: Support and expand public outreach and education efforts (e.g., leave no trace messages) to minimize disturbance or habitat modification in key alpine and tundra habitats.

Action: Support public outreach that increases public awareness of the potential effects of global climate change. Incorporate research results of how global climate change affects wildlife and their habitats as they become available.

Action: Recommend alpine and tundra areas for special management (i.e., Special Interest Areas or Special Management Areas) for inclusion in the Humboldt-Toiyabe National Forest revised management plan and allotment management plan.

Action: Review and provide comments on the final proposed areas for special management that include alpine and tundra habitats in the Humboldt-Toiyabe National Forest Plan Revision and allotment management plan.

Objective: Maintain American pika populations at current range and distribution through 2022.

"current range and distribution" – no extinction of pika at any currently known occupied site as determined by specialized surveys scheduled regularly at intervals not to exceed five years.

Action: Initiate American pika occupancy surveys scheduled to inventory all known occupied sites at least every five years.

Action: Maintain structural components of alpine and tundra habitats important to wildlife, including scree, rockfalls, and subnivean microhabitats.

Action: Inventory historically-occupied sites where American pika have become extinct for suitability of habitat; investigate the appropriateness and feasibility of reintroducing American pika to vacant historic range.

Objective: Maintain birds of conservation priority at current status and trend in alpine habitats through 2022.

"current status and trend" – as determined by Nevada Bird Count, USGS Breeding Bird Survey, or NDOW raptor nesting survey.

Action: Determine breeding status of Rufous Hummingbird in Nevada.

Action: Supplement Nevada Bird Count transect network with targeted alpine transects.

Action: Initiate research of Black Rosy-Finch breeding and wintering ecology and population demography.

Objective: Maintain mule deer and bighorn sheep at current population levels in alpine habitats through 2022.

"current population levels" – as determined by NDOW big game surveys.

Action: Prevent or minimize contact between extant bighorn sheep herds and domestic sheep in alpine habitats.

Objective: Maintain dusky shrew at detectable levels in alpine habitats through 2022.

"detectable levels" – as determined by live trap or pit trap survey conducted at regular intervals not to exceed five years.

Action: Add alpine sites to small mammal surveillance monitoring coverage.

Action: Initiate a statewide shrew distribution and ecology study with emphasis on conservation priority species.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
U.S. Forest Service	84
National Park Service	11
Department of Defense	3
Other	2

Existing partnerships, plans, and programs

- Spring Mountains National Recreation Area Conservation Agreement
- Mount Grant Initial Conservation Assessment

Federal & State Agencies

- U. S. Forest Service
- U.S. Fish and Wildlife Service
- National Park Service (Great Basin National Park)
- Department of Defense (Hawthorne Army Munitions Depot)
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Natural Heritage Program

Bird Initiatives

- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners in Flight

Sportsmen's Organizations

- Nevada Bighorns Unlimited
- Fraternity of the Desert Bighorn

Conservation Organizations

- The Nature Conservancy
- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society
- Sierra Club
- Nevada Wilderness Coalition (Friends of Nevada Wilderness, Nevada Wilderness Project)

Other Key Partners

- University of Nevada
- Counties
- Intermountain West Joint Venture
- Great Basin Bird Observatory

Focal Areas

East Humboldt Range
Independence Mountains
Jarbidge Wilderness
Ruby Mountains
Snake Range
Toiyabe Range
Toquima Range
Wassuk Range

Intermountain Rivers & Streams

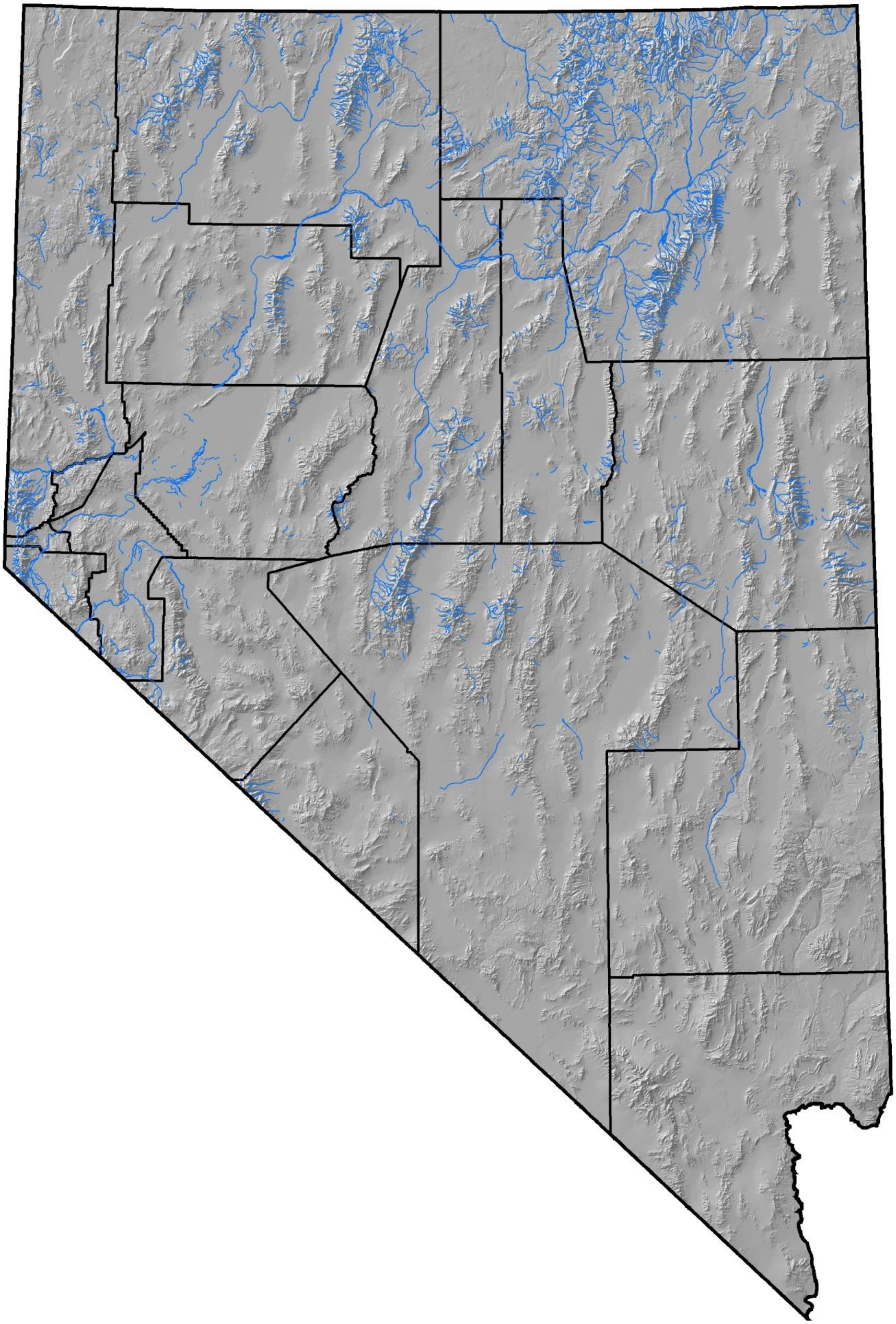


Figure 15: Distribution of Intermountain Rivers and Streams in Nevada.

KEY HABITAT: INTERMOUNTAIN RIVERS AND STREAMS

Things to Know….

- Intermountain rivers and streams include riparian areas, floodplains, and wetlands adjacent to streams and rivers.
- Riparian areas are critical areas of diversity with more than 75% of Nevada's species associated with riparian vegetation.
- Habitat threats include non-native invasive plants, habitat loss or alteration, and hydromodifications.
- Climate change effects will likely increase desertification (entrenchment) and expansion or new invasion of invasive plants.
- Recommended prescriptive actions include weed monitoring and treatment and streambank stabilization, such as rip-rap installation.

Ecoregions

Southwest ReGAP 2005

Great Basin	72,011 hectares	177,939 acres
Columbia Plateau	37,432 hectares	92,495 acres
Mojave	1,141 hectares	2,820 acres
Total	110,584 hectares	273,254 acres

Ecological Systems*

SWReGAP Ecological Systems

S091 Rocky Mountain Subalpine-Montane Riparian Shrubland
S092 Rocky Mountain Subalpine-Montane Riparian Woodland
S118 Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
A002 Intermountain Streams
A003 Intermountain Rivers

*No TNC Biophysical Settings were developed

Key Habitat Description

Riparian areas are most often associated with streams, lakes, and wetlands, but may also occur on upland sites if conditions influenced by topography, elevation, and precipitation produce sufficient soil moisture to support the vegetation types. In montane riparian systems, the vegetation generally follows the saturation zone of a stream course, spring outflow, or catchment basin. Dominant tree and shrub species in these systems may include cottonwood, aspen, alder, birch, willow, wild rose, and red-osier dogwood. Mature plant heights can range from less than two meters to three meters. Left undisturbed, deciduous riparian habitats attain a complex, multi-layered vertical structure with an intermittent to continuous overstory, a midstory that is often dense and impenetrable, and an understory rich in grasses and forbs. Riparian floodplain vegetation is typically heterogeneous.

Lowland riparian habitats are those associated with the floodplains of major river systems primarily occurring below 1,500 meters elevation in the northern two-thirds of the state. Lush habitat conditions supported by these lowland floodplains stand in stark contrast to the arid landscapes through which they course. With the exception of the Humboldt River, lowland riparian habitats are typically dominated by Fremont cottonwood. Several species of willow are found on river floodplains, including sandbar, arroyo, red, Goodding's and shining willow. Buffaloberry is present to varying degrees in all of the northern Nevada river systems. Many of these lowland systems have been invaded by tamarisk and Russian olive.

Meadows of grasses, sedges, and rushes predominate much of the floodplain of the Humboldt River and its tributaries, while occurring on shorter, more disjunct stretches of the other northern Nevada river floodplains. Creeping wildrye is one of the most important meadow grasses. Other plants that may occur within lowland floodplains include saltgrass, greasewood, sagebrush, and wildrye.

Floodplains of intermountain riparian systems vary in width from a few hundred meters in the restricted canyons of the Truckee River to over six kilometers in width in the Carson Valley near Minden, or on the Humboldt River near Battle Mountain. Riparian vegetation is distributed according to different plant species' affinity for water and the extent to which river flow is distributed across its floodplain. Mature plant heights can range from less than two meters for greasewood to 30 meters tall for Fremont cottonwood. Left to their own natural disturbance regimes, habitat structure in lowland riparian areas is substantively similar, though typically wider in extent than montane riparian systems. One expression of cottonwood overstory is called *gallery forest*, where the canopy closes and effectively shades out the midstory, creating a tall, high-canopy forest that can stretch across the floodplain for hundreds of meters.

Stream aquatic habitats within the Intermountain key habitat type vary considerably and can be subdivided into two core habitats assemblages: montane and sub-montane aquatic habitats which support a species assemblage dominated by native andintroduced salmonids; and sub-montane and lowland aquatic habitats which support a variety of native and introduced fishes including, but generally not dominated by salmonid species.

For montane and sub-montane lotic systems which are dominated by salmonid species assemblages, streams and rivers must be narrow and deep with a pool to riffle ratio of 50:50. Pools will vary from less than the average stream width to wider than the average stream width and depth. When streams and rivers exhibit these qualities, along with a healthy riparian to provide cover and stabilize banks, fish densities reach their highest possible levels; provided that water flows remain adequate.

Sub-montane and lowland stream aquatic systems within the Intermountain Rivers and Streams Key Habitat type that support species of conservation concern vary tremendously. Some of these stream systems represent primary order stream reaches within terminal drainage systems or disjunct segments of larger drainage systems isolated by naturally or artificially de-watered reaches, such as upper Meadow Valley Wash. Others are lower order segments of primarily spring fed discharge systems as in upper White River Valley. Again, the isolation and variable aquatic habitat characteristics of many of these stream systems have resulted in their support of unique aquatic species assemblages across the landscape.

Value to Wildlife

Estimates based on the National Wetlands Inventory indicate about 1.5 percent of Nevada's present surface area is vegetated wetlands or open water (E. Skudlarek, Nevada Natural Heritage Program, pers. comm. 2004). Although extremely small in extent, riparian communities are critical centers of wildlife diversity (Mac, 1988).

More than 75% of the species in Nevada are strongly associated with riparian vegetation (U.S. General Accounting Office, 1993), including 80% of the birds (Dobkin, 1998). Almost all of these systems provide surface water for wildlife at some point in the year, and some provide critical year-round water. Because of the presence of water either at or near the surface, riparian systems are the most productive habitats in the state. This includes production of seeds, fruits, insects, arthropods, reptiles, amphibians, and vegetation for wildlife food, and often abundant plant growth that provides nest and den sites, cavity sites, hiding cover, and thermal cover. Another critical function of riparian areas is to provide corridors for either long-distance migration (e.g., birds, bats) or short-distance wildlife movements (e.g., deer, bobcat). By facilitating such movements, riparian corridors connect populations and improve the genetic health of wildlife populations. Wetted backwaters along streams provide excellent habitat for amphibian species, provided that these areas receive adequate water during high flows in the spring.

Because of the relative scarcity of aquatic systems in Nevada's landscape, and the naturally disconnected and fragmented nature of these systems in an arid climate, individual lotic systems in this habitat type become critically important for aquatic species because of the unique species and species assemblages that they support. Nevada ranks sixth nationally in species endemism and third nationally in species at risk (NatureServe, 2002); aquatic and aquatic dependent species represent a significant proportion of these biodiversity and risk indicators. In addition to priority species of conservation concern, many of these aquatic habitat species assemblages also include multiple aquatic endemic species which are at a lower level of conservation priority.

Key Elements of Intermountain Rivers and Streams Habitat Important to Wildlife

MONTANE RIPARIAN

MATURE OVERSTORY – nesting structure (large stems), foraging, roosting, protection from predators

Cassin's Finch
Northern Goshawk

WILLOW/SHRUB MIDSTORY – nesting structure, foraging, protection from predators, thermal cover

Mountain Quail
Mountain Willow Flycatcher (*brewsteri*)
Willow Flycatcher (*adastus*)
Inyo shrew
Montane shrew

HERBACEOUS UNDERSTORY – foraging

Rufous Hummingbird
Virginia's Warbler
Preble's Shrew
western jumping mouse

DISTURBANCE – fire creates suitable conditions for foraging (increased insects) and nesting (substrate for cavity excavation)

Lewis's Woodpecker

CANYON/ROCKS – foraging, protection from predators, thermal cover

Sonoran mountain kingsnake

CHANNEL – species tied to water in the channel for some or all of their life history (e.g., foraging versus spending entire life in the water)

Bank Swallow
water shrew
northern river otter
northwestern pond turtle

LOWLAND RIPARIAN

MATURE OVERSTORY – nesting structure (large stems), foraging, roosting, protection from predators

Bald Eagle
Western Yellow-billed Cuckoo

WILLOW/SHRUB MIDSTORY – nesting structure, foraging, protection from predators, thermal cover

Willow Flycatcher (adastus)

MEADOW – foraging, burrowing

Burrowing Owl
Botta pocket gopher
Preble's shrew

SUB-MONTANE AND LOWLAND STREAM AQUATIC SYSTEMS – physiographic grouping of aquatic species

cui-ui
Lahontan cutthroat trout
northern leopard frog
Alvord chub
Independence Valley speckled dace
Independence Valley tui chub
Big Spring spinedace
Railroad Valley tui chub
California floater
Wall Canyon sucker
Warner sucker
White River desert sucker

MONTANE AND SUB-MONTANE SALMONID STREAM SYSTEMS – physiographic grouping of aquatic species

bull trout
Lahontan cutthroat trout
White River speckled dace
White River spinedace
Inland Columbia Basin redband trout
Warner Valley redband trout
Yellowstone cutthroat trout
mountain whitefish
northern leopard frog
Columbia spotted frog

Existing Environment

Land Uses

- Agriculture
- Livestock grazing
- Hydroelectric power production
- Irrigation diversion
- Flood control
- Groundwater development
- Motorized recreation
- Non-motorized recreation
- Recreation development
- Urban/suburban development
- Road development
- Species harvest

Habitat Conditions

Riparian systems in Nevada are extremely important to both humans and wildlife, and the myriad demands placed on these systems have often meant an increase in value for one user at the expense of another. Every riparian system in the state has been altered in some fashion from its condition at the time of Euro-American settlement. Alterations have not always manifested themselves in a manner that has led to declines in wildlife habitat quality or quantity, but it would be impossible to go anywhere in the state and identify a site in its natural condition. Certainly some riparian systems have been lost entirely or altered so dramatically that they no longer offer the range of habitat opportunities that they would offer if they were unmanipulated or perhaps better managed. To date no work has been done to clearly define how much of its riparian areas the state has lost. Given that California has lost about 95% of its wetlands (a broader category that includes riparian areas), and Utah about 90%, Nevada probably deviates little from this pattern.

Riparian systems in Nevada evolved in the presence of dynamic annual water cycles. Riparian sites are typically adapted to flooding driven by snow melt, followed by a gradual decline in surface flows. In lowland riparian systems, the river channels themselves were dynamic, shifting with floods to abandon old channels and create new waterways, all the while leaving behind regenerating forests while older habitats gave way to scouring water. Dams to control floods and regulate the distribution of water have forever altered this natural process, while groundwater pumping has also affected surface flows in some areas.

Riparian areas have also been affected by concentrated grazing, cutting for timber and firewood, residential development, river channelization, diversion, industrialization, log drives, wildfire suppression, trapping (principally beaver), exotic species (both plants and animals), unregulated recreation (both motorized and non-motorized), road building, mining, pollution, farming, channel dredging, bank armoring, and construction of dams and levees.

Invasive plants may be one of the greatest agents of change in these systems. Tamarisk is an exotic riparian tree that has invaded all of Nevada’s river systems to varying degrees. Another aggressive exotic invader present on Nevada’s rivers is Russian olive. These exotics have replaced the native midstory on many stretches of Nevada’s rivers. Tamarisk has made considerable inroads in the Humboldt system and dominates the extensive delta of the Walker River. Russian olive is particularly prevalent on the Carson River below Dayton. Tall whitetop is another noxious weed invading riparian areas in northern Nevada. The highly invasive nature of both tamarisk and tall whitetop gives them the ability to convert entire landscapes into undesirable monotypes.

All aquatic habitat systems in Intermountain rivers and streams have been altered or modified to some degree from historic conditions, through actions such as channelization, construction of dams and diversions, regulation of flows or diversion of flows for agriculture, recreational and urban development and the introduction of non-native aquatic species. The level of this alteration ranges from severe, on the lower Truckee River where river flows are highly regulated and substantially diverted for agriculture (at times leaving the Truckee River completely dry), to relatively minor in some montane stream drainage systems. Although many montane or sub-montane stream systems are relatively free flowing within terminal or connected basin systems, a substantial number of these systems are impacted by existing land use practices such as inappropriate livestock grazing. The construction of impoundments and reservoirs has affected some stream systems including Wall Canyon and upper Meadow Valley Wash, where impoundment for recreation has altered seasonal flows and natural geomorphic process by complete capture of surface flows in most years, leaving downstream stream reaches dependent on spring and groundwater flow for maintenance of aquatic habitats. Extensive alteration of natural channels and diversion of flows for irrigation has resulted in fragmentation and isolation of stream habitats in the Upper White River Valley.

Problems Facing the Species and Habitats

Many of the sources of stress identified above under Habitat Conditions continue to exert pressure on riparian habitats in Nevada. As a result, riparian habitats continue to face permanent or temporary loss or modification of habitat integrity. For wildlife, this means reduced vegetation composition, structure, and cover resulting in loss of nesting cover, escape cover, food sources. Dams and diversions continue to modify hydrologic regimes, interrupting natural flow dynamics that result in modified channel and floodplain processes, and creating barriers to fish movement and migration which fragment aquatic habitats. Pumping of surface waters and connected aquifers alters groundwater flow and recharge patterns. Recreation, development, and grazing create disturbance to wildlife (including movements/displacement, behavior, reproductive success) and encourage habitat fragmentation. Erosion is also hastened by recreational activities, invasive plants, poorly functioning hydrological regimes, grazing, and development. Invasive plants are in places converting landscapes to monocultures of single plant types that offer far fewer habitat values for wildlife than native communities. Improper placement of roads has also led to erosion, siltation, disturbance to wildlife, and habitat fragmentation. Finally, as wildlife concentrates in riparian habitat, so too do those who pursue illegal activities such as poaching and illegal collection.

Predicted Climate Change Effects

Riparian habitats

Three major problems affect riparian habitats in Nevada: The invasion of exotic forbs and trees such as tall whitetop, noxious thistles, Russian olive, and tamarisk; the entrenchment of flow channels; and the loss of perennial flow in non-carbonate waterways (i.e., conversion to desert washes). Characteristic classes for intermountain riparian vegetative systems are early (0-50% native cover 0-5 yrs old), mid-open (31-100% native cover 5-20 yrs old), and late closed 31-100% cover >20 yrs old). Reference conditions indicate roughly an equal three-way split between the three characteristic classes in good health. Uncharacteristic classes include exotic forb and tree species (>5 percent exotic forb and tree cover), desertified (entrenched with 10-50% upland shrubs), pasture (haymeadow tended for agriculture with or without introduction of palatable grasses), and shrub-forb-encroached (10-50% cover unpalatable shrubs such as Woods' rose and sumac). Loss of perennial flow results in a conversion to desert washes.

Non-carbonate

Current conditions of non-carbonate riparian systems statewide are unfavorable – only three regions in the state (Eastern Sierra, Toiyabe, and Tonopah) currently have over 60% of their extent in characteristic classes. The other 10 regions have over 40% of their riparian systems in entrenchment or exotic species invasion, ranging from a low of 43% in the Elko region to a high of 88% in the Clover region. Considerable variation exists between regions as to whether the systems are predominantly entrenched or weed-invaded— five regions each. Of the 10 regions, the western/southern ones tended to be primarily weed-invaded while the eastern/northern ones tended to be primarily entrenched. Fifty years of climate change are predicted to increase the percentages in uncharacteristic classes even more, usually at the expense of the early-succession class. Not surprisingly, the regions that will change the least in 50 years (less than 10% increase) are the ones that are currently the most deviated – the remaining increment from 80 to 100% being much less than say, from 50%. The remaining regions of the "10 most deviated" were predicted to increase 12 to 15% in uncharacteristic class percentages. The three regions under 40% deviation were predicted to increase a little more, between 17 and 24%. All would then be over 50% deviated from characteristic classes. The most unfavorable result is the permanent conversion of perennial waterways into desert washes in all regions due to increased evapotranspiration. Regional differences exist in conversion to desert washes: the highest losses between 9% and 13% are predicted in the Eastern Sierra, Eureka, Humboldt, Tonopah, Toiyabe, and Walker regions; intermediate losses between 3 and <9% are predicted for the Black Rock, Elko, Lahontan, and Mojave regions; and losses <3% are found in the Clover and Owyhee regions.

Carbonate

Carbonate-based riparian systems occur in three regions in Nevada – Calcareous, Clover, and Mojave. These systems are already over 50% entrenched in all three regions. The percentages of classes invaded by exotic species vary from four percent in the Mojave, nine percent in the Calcareous Ranges, to 19% in the Clover Valley region. Entrenchment is not predicted to increase more than one or two percent for any of the three regions with 50 years of climate change. Exotic species invasion will increase from three to nine percent and the resulting total percentage of vegetation weed-invaded will range from 15 to 22% among the three regions. No conversion to desert washes occurs on carbonate geology due to the buffering of the aquifer.

Aquatic habitats

Potential climate change effects on intermountain river and stream aquatic habitats are driven by predicted changes in two key interlinked components of climate, precipitation and air temperature. Interannual increases in average air temperature are well documented and this trend is expected to continue or accelerate through 2050 across Nevada particularly in summer through late winter periods in northern and central areas of the state. Although most available precipitation models suggest a substantive increase in fall and winter precipitation and hence available snowpack especially in northeastern and north-central Nevada during the same time period, interaction with increasing air temperatures is likely to offset much of the benefit of that precipitation in maintaining seasonal streamflows and aquatic habitat quality in many intermountain river and stream systems. Observed trends under current conditions across the Great Basin already support substantially earlier timing of spring runoff conditions in many lotic systems and this trend is likely to accelerate. This likely trend towards reduced snowpack duration and increased precipitation as rain particularly in lower elevation and more southerly watershed basins can be expected to particularly, and negatively impact recharge of local and non-carbonate aquifer systems supporting the quality and quantity of aquatic system base flows especially in lower elevation and hydrographically isolated stream and river reaches. Available models also suggest that the most substantial decreases in average precipitation can be expected in the March through August periods, and for air temperature the most significant increases in June through September. When coupled with early onset of annual runoff events, these changes are likely to significantly impact many flowing aquatic systems with reduced average summer and fall base flows, and increases in in-channel water temperatures. Although some, particularly smaller, isolated or higher elevation streams will be influenced by local variation in year-to-year conditions that may mitigate some of these effects, the likely general trend for intermountain river and stream conditions will be towards earlier onset of spring runoff with the potential for, periodically, higher intensity and shorter duration runoff events, and longer periods of low seasonal base flows during the summer and fall particularly for lower elevation reaches.

Possible Wildlife Responses to Climate Change

Desertified (entrenched) riparian systems are practically uninhabitable by species that specialize in “riparian” vegetation (e.g., willows, cottonwoods, birch, alder, etc.). Increases in riparian desertification predicted for the non-carbonate systems in several regions will result in displacement of cottonwood-willow-alder associated species. The impacts of exotic species invasion are much more difficult to assess and predict, because a system invaded by exotic species by five percent (but not desertified) is probably still providing traditional riparian habitat, while a system invaded 100% with exotics is expected to provide little or no habitat for “riparian-associated” species. One would expect a gradual reduction in native plant density and occupation until riparian vegetation had been replaced to an extent it could no longer function as traditional riparian wildlife habitat. The rate of species dropout under such a scenario is not well-studied and will need to be understood and monitored through the life of this Plan.

Meadow Species

Bobolink	Sandhill Crane
Long-billed Curlew	Short-eared Owl

Of 31 terrestrial Species of Conservation Priority considered to be significantly associated with intermountain riparian habitats in Nevada, four are predominantly associated with open meadow habitats with some willow occurrence – Bobolink, Long-billed Curlew, Sandhill Crane, and Short-eared Owl. Bobolink and Long-billed Curlew use tall, unmowed meadow grasses with Bobolink more dependent on flooding to protect nests from predators and the curlew more impacted by flooding if fluctuations are frequent and wide in amplitude. Sandhill Cranes and Short-eared Owls are more tolerant of willow growth in the meadow, but still prefer open meadow and shun tree (black willow-cottonwood) overstory. Succession analysis indicates that most of the transitions to weed-invaded classes will come from the early (A) riparian class in non-carbonate systems. All four of these species are northerly distributed in the state and stand to be most impacted by weed invasion, which at its extreme extent could conceivably render habitats unsuitable for their use at local scales. Studies are lacking, but incremental impacts could begin at around 30-35% exotic forb coverage. Beyond that, emigration away from the impacted habitat could be expected to accelerate to eventually zero occupation.

Losses of early-class riparian habitat in the Elko and Humboldt regions ranging from 15 to 30% could have a measurable impact on the distribution of all four species without the ameliorative effect of managed pasture. Pastures managed for quality grass hay (assuming active weed management on private lands) and left uncut through most of the breeding season can serve as functional surrogates for natural early class meadows, thus highlighting the importance of private lands to these species.

Shrub Mid-Story Species

Common Nighthawk	Willow Flycatcher
Mountain Quail	Preble's shrew
Rufous Hummingbird	mountain beaver
Virginia's Warbler	

Seven intermountain riparian Species of Conservation Priority are generally considered to need some kind of shrub midstory to provide nesting substrate, escape/thermal cover, or both. Of these, two breeding birds (Virginia's Warbler, Willow Flycatcher) are the least flexible in their preference for dense shrub cover, even though Virginia's Warbler is a ground-nesting species. The other five – Mountain Quail, Rufous Hummingbird, Common Nighthawk, Preble's shrew, and mountain beaver – exhibit more flexibility in their use of mixed riparian habitats consisting of meadow grasses, willow-alder midstory, and cottonwood overstory, but are not expected to be particularly facilitated by the maintenance of managed haymeadow (pasture). Reductions in percentages of mid- and late-succession classes of intermountain riparian (carbonate and non-carbonate) were predicted to remain below 10% in nine of the 13 regions. Regions with reductions greater than 10% included Humboldt (11%), Calcareous non-carbonate (13%), Toiyabe (19%) and Mojave non-carbonate (23%). Reductions in shrub midstory at these higher levels might differentially target Virginia's Warbler and Willow Flycatcher in these regions, although no regions are expected to lose any of the shrub-associated species completely.

Meadow-Shrub-Tree-Pasture Species

Botta pocket gopher	Pahranagat Valley montane vole
Inyo shrew	northern river otter
Merriam's shrew	water shrew
montane shrew	western jumping mouse
mountain pocket gopher	ring-necked snake

Ten species are considered to utilize riparian habitats in a variety of their native forms, can also use managed pasture, but are expected to be impacted by desertification and/or exotic forb invasion in its heavier expressions. All but two of these 10 species are grass/forb understory –associated but with tolerances for shrub-tree overstories. The expectation that these species will also use managed pasture without shrub-tree overstory separates them from the previous grouping. The heaviest transitions from characteristic to non-charasteristic classes are predicted in the southwest-central regions (Eastern Sierra, Walker Corridor, Toiyabe, Tonopah, and the high-elevation Mojave), possibly singling out the Botta pocket gopher complex for targeted impacts since the species and its network of geographically isolated subspecies are concentrated in that general region.

Northern river otter and water shrew are two mammals most closely associated with the river channel itself, but are sensitive to water quality and prefer escape cover along the banks, thus they thrive where native riparian vegetation populates and armors streambanks against erosion and the resultant streamflow siltation. The river otter is most abundant in the Humboldt River and its largest connected tributaries (the Little Humboldt is connected to the mainstem by subsurface flow). The Elko, Eureka, and Humboldt Ranges are predicted to experience 12-15% increases in uncharacteristic classes (primarily exotic forb invasion) over the next 50 years, but it is hard to predict whether those changes will occur primarily in the mountain streams (no otters) or the lowland mainstem channels, so while some deterioration of otter habitat suitability is expected, it is not possible to quantify. The same uncertainty exists for water shrew, but it is distributed over both mountain streams and valley mainstems and could experience habitat deterioration at either.

Mature Cottonwood Overstory Species

Lewis's Woodpecker	Cassin's Finch
Western Yellow-billed Cuckoo	red bat

Four species are considered to require mature cottonwood overstory to satisfy critical life-history needs in riparian habitats – Lewis's Woodpecker, Yellow-billed Cuckoo, Cassin's Finch, and red bat. Lewis's Woodpecker's use of mature trees in riparian/aspen has already been discussed in the Aspen chapter. Lewis's Woodpeckers are not great excavators and require soft or weakened tree phloem for excavation of new nest cavities or adaptation of existing ones. In the western states, the Yellow-billed Cuckoo is an increasingly rare summer resident of lowland mainstem river systems supporting extensive "gallery" cottonwood forests. In Nevada's Great Basin, only the Carson River above Lahontan Reservoir has been regularly occupied by Yellow-billed Cuckoos during the last 25 years. The Truckee River has undergone significant habitat restoration under the leadership of The Nature Conservancy over the last 20 years and could be on track to support suitable cuckoo habitat in the next decade or so. Red bats share the same preference for lowland gallery cottonwood forests as cuckoos. The Cassin's Finch resides in the highest elevations of the cottonwood zone in riparian habitats within pinyon-juniper uplands or coniferous forest.

The bulk of lowland mainstem riparian typically supporting gallery cottonwood forest occurs in the Eastern Sierra region where late-closed "montane riparian" is expected to remain constant over the next 50 years (Appendix C), but conversions from early and mid-open classes to exotic forbs could negatively impact the maintenance of late-closed canopies over the following 50 years (post-2022) if action to stem the advance of exotic species invasion is not taken.

Similar predictions are made for the Black Rock region where isolated populations of Lewis's Woodpeckers live in the cottonwood forests of the Santa Rosa Mountains. Late-closed percentages would remain stable through 2022, but loss of early and mid-open classes to exotic forb invasion could impact replacement of mature cottonwood into the next 50-year interval post-2022. In the Elko region, desertification has already impacted 40% of riparian habitats, and a five percent decrease in late-closed is predicted to occur along with the loss of early/mid-open classes to exotic forb invasion. The response of Lewis's Woodpeckers to these trends likely would warrant monitoring, especially if continental population trends for the woodpecker continue to decline or fail to recover.

Other Species

Bank Swallow	northwestern pond turtle
mule deer	northern rubber boa
Western red-tailed skink	

A small group of species seemed to be associated to riparian habitats for a variety of reasons that did not seem to be impacted heavily by ecological departure. Of these the most conspicuous and surprising might be mule deer, a species that benefits from the high productivity of riparian meadows and shrub mid-stories, but also will use tall whitetop for thermal and protective cover, particularly for day-use prior to moving into open meadows to graze at night.

Bank swallows excavate nest holes in cut banks and nest in colonies of a few pairs up to 2,000 pairs or more

(Garrison, 1999), so it would seem this would not be a species one would use to represent functional riparian habitat health, but the species continues to demonstrate continental and regional population declines worthy of monitoring and possibly yet to be understood in other terms of its life history needs. Western red-tailed skink and northern rubber boa are considered riparian-associated because they are often found in the moister habitats provided by rivers and streams and their floodplains. Western red-tailed skink primarily occurs in the Mojave region, where it would be found in "montane riparian" habitats at the higher elevations above what would be known as "warm desert riparian" (in which it is also found). The northwestern pond turtle is dependent on channel flow and no particular sensitivity to the presence or quality of bank vegetation has been reported. The species may in fact be more connected to submergent aquatic vegetation in the main channel and open backwaters than it is to riparian terrestrial vegetation.

Aquatic priority species

Predicted changes in temperature and precipitation on intermountain river and stream systems, in general, will impact resident priority aquatic species in several specific ways, with the understanding that effects are likely to vary substantially dependent on local watershed and snowpack conditions that are anticipated to be highly variable from year to year. Climate change effects on total snowpack accumulation in specific watersheds is difficult to predict, but expected changes in snowmelt timing as characterized by earlier spring onset will functionally result in changes in the timing, magnitude and duration of seasonal stream flows. These changes in timing and characteristics of peak flows have implications for habitat quality to the extent that they modify current processes essential for maintaining channel characteristics, sediment deposition and the maintenance of instream habitats for spawning, juvenile recruitment and summer maintenance of all age classes of native fishes. Lower summer base flows driven by reduced summer through early fall precipitation, in combination with summer period temperature rise, can be expected to result in increased water temperatures particularly in smaller, isolated and lower elevation stream and river systems with a more frequent occurrence of individual stream and river segments approaching or exceeding thermal maxima for resident fishes, particularly native salmonids. Even where individual stream reaches may stay wetted, reductions in suitable habitat can be expected with resultant contraction of available range for many species. For more broadly distributed fishes the implications include an increased potential for loss of connectivity and range fragmentation, reductions in population sizes and possibly local extinctions associated with thermal regimes and habitat availability. For all native fish species associated with these systems, these processes will act on individuals as well with potential negative effects on survivorship and mortality, condition and growth associated with changes in stream food webs and energy balance, and microhabitat changes within individual stream segments affecting habitat characteristics for critical life stages and behaviors, the availability of low-flow thermal refuges and exposure to predators and competitors. The potential exists in many systems as well for changes in species assemblages because of range shifts by co-existing species and the enhanced opportunity for invasive, non-native species persistence under warmer and more variable flow conditions.

Sub-Montane and Lowland Stream Aquatic Systems

cui-ui	Northern leopard frog
Lahontan Cutthroat trout	Alvord chub
Indepenedence Valley speckled dace	Independence Valley tui chub
Big Spring spinedace	Railroad Valley tui chub
California floater	Wall Canyon sucker
Warner sucker	White River desert sucker

Several priority aquatic species have a particular dependence on lower elevation intermountain river and stream systems for all or part of their life cycles. Predicted trends for temperature are similar across northern Nevada, but some models suggest more severe reductions in average precipitation in western areas of the state and those drainages associated with the Sierra front particularly in the spring through early fall periods. Species associated with larger sub-montane river systems including cui-ui and Lahontan cutthroat trout will face particular challenges given the likelihood of reductions in base flows during summer low-flow periods with resultant affects on habitat quality and instream thermal characteristics as described previously. Although effects to species associated with isolated drainage systems such as tui chub are more difficult to predict because of the uncertainty of at least short-term changes on individual watersheds, impacts during summer season low flow conditions in the future are likely to be similar with the potential for contractions in available range and increased thermal stress in areas of occupied habitats. The possible exception to this scenario is Big Spring spinedace; occupied habitat for that species although stream-based is more dependent on base flow from spring systems associated with carbonate regional aquifers and potential impacts are associated with the potential for increased monsoonal summer storm events and increased unpredictability in the frequency and magnitude of peak flow events altering habitat quality and characteristics.

Montane and Sub-Montane Salmonid Stream Systems

bull trout	Lahontan cutthroat trout
White River speckled dace	White River spinedace
Yellowstone cutthroat trout	northern leopard frog
Inland Columbia Basin redband trout	Columbia spotted frog
Warner Valley redband trout	mountan whitefish

Predicted changes as previously described are anticipated to have the most significant effect on salmonid species inhabiting these moderate to higher elevation stream and small river systems, with those effects more prevalent in northeastern and north-central Nevada systems. Although across much of this part of the state total winter precipitation is expected to increase, predicted changes in air temperatures are likely to continue trends towards earlier spring onset. Associated effects will include changes in annual timing and intensity of spring runoff events, followed by likely reductions in late spring through summer base flows. Similar to effects on salmonid species in other sub-montane and lowland stream systems, reduced warm season base flows associated with both earlier spring runoff and predicted reductions in summer period precipitation have a high potential to alter thermal characteristics of lower elevation salmonid habitats, with at least some systems having an increased likelihood of exceeding thermal maxima and loss of habitat suitability for native salmonid species periodically dependent on individual years' conditions. Although all native salmonid species face potentially significant range contraction and loss of connectivity for existing populations, the highest risk for impacts is to bull trout; the occupied range for this species is severely constrained in Nevada because of thermal characteristics under existing conditions and substantive additional range contraction would be likely. Non-salmonid White River native fishes, although utilizing higher elevation stream systems, also occur in lower-elevation spring-based outflow systems dependent, in some cases, on regional carbonate aquifer groundwater systems likely less subject to near-term effects from predicted air temperature and precipitation changes. Even within occupied stream reaches, effects would be less than that anticipated for native salmonids and little short term effect is anticipated in these habitats for those species through 2022.

Taking Prescriptive Action

During our consultation with restoration experts, three simple prescriptions were selected as most effective for restoring departed montane riparian systems – weed inventory (spot control) for small streams, exotic species control for larger floodplains, and rock riffle installation in entrenched streams. Exotic weed control costs varied significantly with respect to the tasks involved. Where spraying was all that was needed, costs ran $40-50 per acre, but if tamarisk cutting and painting was involved, costs jumped to $250-350 per acre. In the Calcareous region, treatment using a combination of all three treatments reduced entrenchment by five percent and prevented exotic weed invasion by 66% over 50 years. Exotic weed control modeled in the Lahontan and Walker regions reduced exotic weed invasion by 33% and reduced by 20% in the Mojave region (TNC, 2011). The benefits to wildlife were expected to be best realized in recruitment into the mid-open and late-closed classes after 2022.

Priority Research Needs

- Species of conservation priority responses to incremental exotic weed invasion – tolerance thresholds.
- Effective methods for control and eradication of invasive aquatic species
- Methods of management of riparian systems to mimic natural cycles addressing the life history needs of riparian and aquatic wildlife
- Distribution, population demography, and genetic analysis of willow flycatcher subspecies (*adastus, brewsteri*)
- Distribution and habitat preference of western jumping mouse and western red bat.
- Status, distribution, and habitat use of Western Yellow-billed Cuckoo on the Carson River
- Update distribution, genetic analysis, and population viability analysis for Botta pocket gopher.
- Identify and survey potential northern leopard frog sites to better determine current distribution.
- Identify cost-effective low technology actions to slow conversion of montane riparian streams into desert washes.

Conservation Strategy

Goal: Healthy, self-sustaining wildlife populations in diverse native plant communities free of non-native, invasive species on floodplains hydrologically connected to associated channels; thriving mature cottonwood or aspen overstory with healthy prospect of regeneration on appropriate sites; willow/tall woody shrub mid-story under cottonwood/aspen or overstory where those species are absent; thriving herbaceous understory and meadows.

Objective: Limit the increase in weed-invaded and/or entrenched riparian systems to less than 10% through 2022.

Action: Define and describe fully-functioning riparian terrestrial wildlife habitats beyond Proper Functioning Condition; integrate WAP Species of Conservation Priority riparian habitat objectives and actions into BLM Resource Management Plans, Forest Service Forest Plans, National Wildlife Refuge Comprehensive Conservation Plans, and other pertinent land use plans.

Action: Develop riparian wildlife objectives and best management practices; incorporate into NRCS Nevada WHIP Plan; in cooperation with NRCS, develop wildlife consultation services that provide quantified wildlife outputs for NRCS project proposals (WHIP, EQIP, Wetlands Reserve Program, Cultural Resources Preservation, etc).

Action: Restore fully-functioning riparian terrestrial wildlife habitats through progressive livestock grazing strategy design, riparian fencing, restoration of hydrologic function through channel modification and water table raising techniques, and planting of riparian vegetation.

Action: Restore riparian plant communities invaded by tamarisk, whitetop, and other non-native plants through aggressive removal of invasives and active restoration of native vegetation.

Objective: Maintain healthy populations of Species of Conservation Priority at stable or increasing trend.

Action: Adapt PIF species objectives and targets for intermountain rivers and streams species to Nevada scale; determine habitat capability for achievement of PIF targets; implement habitat improvement projects designed to improve habitat capability for achievement of PIF population targets; measure project efficacy using bird population parameters.

Action: Delineate distribution and population demography for the *brewsteri* and *adastus* subspecies of Willow Flycatcher.

Action: Delineate distribution, status and trend for western jumping mouse and western red bat.

Action: Update distribution, genetic analysis, and population viability analysis for Botta pocket gopher.

Action: Periodically monitor population status of Yellow-billed Cuckoo in the Carson River between Weeks Bridge and Lahontan Reservoir.

Goal: Fully functioning aquatic habitat ecosystems which support diverse natural species assemblages; maintenance of natural geomorphic stream channel functions with dynamic interaction of riparian and aquatic habitats within constraints of human need and existing infrastructure development; reduced impacts on aquatic habitats from invasive plant and animal species.

Objective: Increase total linear kilometers of fully functioning riparian aquatic habitat on intermountain rivers and streams by 2022.

Action: Work cooperatively with land management partners to implement strategies to improve stream system functions exceeding BLM PFC standards, where appropriate achieving riparian community associations at PNC.

Action: Implement existing strategies to address and eliminate potential movement barriers to reconnect fragmented stream habitat complexes.

Objective: Maintain healthy populations of aquatic Species of Conservation Priority at stable or increasing trend

Action: Implement private landowner cooperative agreements and programmatic Safe Harbor Agreements and similar programs to restore or maintain aquatic habitats for Lahontan cutthroat trout and other priority aquatic species.

Action: Continue the recovery implementation processes for upper White River Valley native fishes.

Action: Implement cooperative conservation strategies for Columbia spotted frog in the Toiyabe Range and Northeastern Nevada as identified in the Columbia Spotted Frog Conservation Agreements and Strategies.

Action: Continue cooperative efforts to identify fish passage barriers and incorporate data into the Nevada Fish Passage database.

Action: Develop new and implement existing strategies to address and eliminate potential movement barriers to reconnect fragmented stream habitat complexes.

Action: Work with private water right holders to manage water diversions with the goal of maximizing low-flow period base flows and where feasible restoring natural flow regimes.

Action: Identify stream and river reaches where there is a need to apply for in-stream flow water rights for SOCP and pursue acquisition of those rights where feasible

Action: Identify locations where screening is needed to prevent fish loss/entrainment in water diversions and implement corrective actions in cooperation with owners or operators.

Action: Support actions by land management partners and local governments to control invasive and noxious plants and weeds, especially tamarisk and emergent plant species which directly impact functioning of lotic aquatic habitats.

Action: Identify priority conservation actions and develop a recovery implementation process for Independence Valley tui chub and speckled dace.

Action: Continue implementation of recovery processes for Big Spring spinedace including restoration of riparian function and stream channel dynamics in 4 km of Condor Canyon.

Action: Implement management and conservation actions for Railroad Valley tui chub and other isolated tui chub subspecies as identified in the species management plan.

Action: Continue implementation of recovery processes for Lahontan cutthroat trout, including action items identified in the species recovery implementation plans and species management plans.

Action: Continue implementation of conservation team processes for Bonneville, Redband, and Yellowstone cutthroat trout, including action items identified in the species conservation and species management plans.

Action: Continue implementation of conservation team processes for Wall Canyon sucker, including active control of invasive aquatic species and other action items identified in the draft species management plans.

Action: Develop a comprehensive statewide database of historic and current northern leopard frog records.

Action: Establish a conservation team for the northern leopard frog to identify priority conservation actions and implement them.

Action: Identify appropriate survey methods and implement status monitoring for northern leopard frog at historic and potential locations to better determine current distribution.

Partnerships

Land management/ownership

Land Owner/Manager	Percent
Private	56.7
Bureau of Land Management	18.6
U.S. Forest Service	18.6
Tribal	3.8
Other	2.3

Existing partnerships, plans, and programs

- Lahontan Cutthroat Trout Recovery
    - Distinct Population Segment Recovery Teams
    - Quinn/Black Rock
    - Upper Humboldt
    - Western
- Bull Trout Recovery Plan

Recovery Implementation Teams (RIT)

- White River
- Railroad Valley
- Big Spring Spinedace

Conservation Agreements

- Northeast Columbia Spotted Frog
- Toiyabe Columbia Spotted Frog

Federal & State Agencies

- Nevada Department of Wildlife
- Bureau of Land Management
- U.S. Forest Service

- U.S. Fish & Wildlife Service
- Bureau of Reclamation

Counties
- Northeast and Toiyabe Columbia Spotted Frog Conservation Agreements
- Truckee-Carson Irrigation District
- Walker River Irrigation District
- County Resource Plans
- Churchill County Quality of Life Plan
- Lower Truckee River Restoration Advisory Committee

Conservation Organizations
- The Nature Conservancy
    - Truckee River Project
    - Carson River Project
- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society Important Bird Areas Program
- Sierra Club

Bird Conservation Initiatives
- Partners In Flight
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight & Nevada Bird Conservation Plan
- U.S. Shorebird Conservation Plan
- Intermountain West Regional Report
- North American Waterbird Conservation Plan
- Intermountain West Waterbird Conservation Plan

Other Key Partners
- Intermountain West Joint Venture/Nevada State Steering Committee

Focal Areas

Adobe Range	Jarbidge Wilderness	Salmon Falls Creek Area
Black Rock Desert Wash	Mary's River	Salmon River Range
Bruneau River	Montana Mountains	Santa Rosa Range
Carson Range	O'Neil Basin	Snake Mountains
Carson Sink	Owyhee Desert (South Fork Owhyee Drainage)	Truckee Meadows
Carson Valley	Owyhee River Area	Tuscarora Mountains
East Humboldt Range	Pahranagat Valley	Wall Canyon
Goose Creek	Pyramid Lake Valley	Wassuk Range
Huntington Valley	Railroad Valley	West Fork Beaver Creek
Independence Mountains	Ruby Mountains	White River Valley
Also:	Humboldt River and tributaries	Pyramid Lake
Carson River	Jarbidge River and tributaries	Truckee River

Warm Desert Riparian

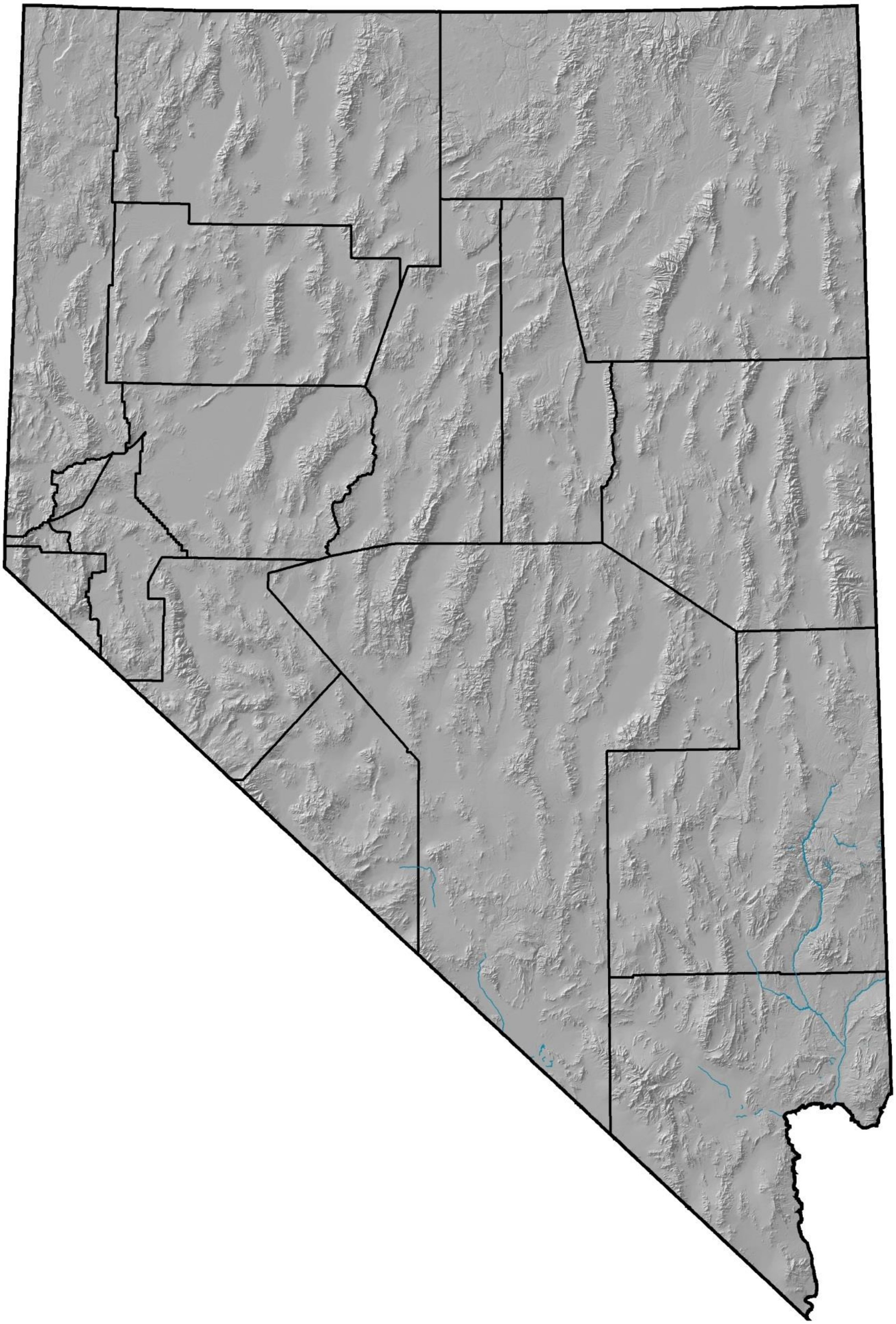


Figure 16: Distribution of Warm Desert Riparian in Nevada.

KEY HABITAT: WARM DESERT RIPARIAN

Things to Know….

- Warm desert riparian include the drainages of the Colorado River and its tributaries. Fremont cottonwood, Goodding willow, velvet ash, honey and screwbean mesquite are the dominant woody plants.
- The cottonwood overstory, mesquite/willow understory, and herbaceous understory support their own wildlife communities.
- Development and invasive species are the greatest habitat threats.
- Climate change effects will likely increase desertification (entrenchment) and expansion or new invasion of invasive plants.
- Recommended prescriptive actions include weed monitoring and treatment and streambank stabilization, such as rip-rap installation.

Ecoregions:

Southwest ReGAP 2005

Mojave	10,812 hectares	26,717 acres
Great Basin	7,778 hectares	19,220 acres
Total	18,590 hectares	45,937 acres

Ecological Systems

TNC Biophysical Settings	*SWReGAP Ecological Systems*
Warm Desert Riparian …………….	S094 North American Warm Desert Lower Montane Riparian Woodland and Shrubland
	S097 North American Warm Desert Riparian Woodland and Shrubland
	S024 Rocky Mountain Bigtooth Maple Ravine Woodland
	D04 Invasive Southwest Riparian Woodland and Shrubland
	A008 Mojave Streams
	A009 Mojave Rivers

Key Habitat Description

The Warm Desert Riparian key habitat type includes the drainages of the Colorado River and its tributaries, the Amargosa River flow system. Dominant woodland species include Fremont cottonwood, Goodding willow, velvet ash, honey mesquite, and screwbean mesquite. Key shrubs include quailbush, seepwillow, coyote willow, wolfberry, and arrowweed. California fan palm oases are present sporadically in the Mojave drainages. Much of the Colorado River system that has not been inundated by major power dams has seen its riparian plant communities invaded by tamarisk. Where tamarisk has successfully invaded the Mojave floodplains, it has largely replaced native woody vegetation. Mojave Desert montane streams occur primarily in the Spring Mountains, and are largely characterized by the presence of arroyo willow.

Aquatic systems within this key habitat type vary tremendously. Mojave River habitats include a segment of the mainstem Colorado River, the Virgin River, and Muddy River. Riverine reaches of the Colorado River are highly modified and channelized with variable flows but many reservoir-like characteristics. The Virgin River is a semi-ephemeral system dependent on seasonal runoff to maintain aquatic habitat characteristics compared to the Muddy River which is a relatively stable flow system dependent on spring discharge. The great variability among Mojave rivers maintains unique aquatic species assemblages in each flow system. Mojave stream systems are generally disconnected stream segments that may be seasonally ephemeral, such as the Amargosa River in Oasis Valley, or represent lower order segments of primarily spring fed discharge systems such as in Pahranagat Valley or Meadow Valley Wash. Again, the isolation and variable aquatic habitat characteristics of these stream systems have resulted in their support of unique aquatic species assemblages across the landscape.

Value to Wildlife

The rivers and streams coursing through the Mojave Desert truly serve as oases in an otherwise dry and largely inhospitable landscape. There are three distinct elements of the Mojave lowland riparian community that each more or less support their own wildlife community – cottonwood overstory, mesquite/willow midstory, and herbaceous understory. The cottonwood overstory is the least prevalent of the three, but where it is present its contribution to wildlife diversity in the Mojave biome is unique and considerable. The scattered cottonwoods on the Colorado River tributaries (Virgin, Muddy, and Pahranagat) are the last places in Nevada where the Yellow-billed Cuckoo can reliably be expected to occur. Sharing preference with the cuckoo for the cottonwood canopy are the Summer Tanager and Brown-crested Flycatcher, each of which occur in Nevada in cottonwood on the Colorado tributaries as well as in some of the creeks of the Spring Range. Western red bats also prefer cottonwood canopy for roosting. Goodding willow can reach overstory sizes and surrogates for cottonwood in some places.

The native mesquite/willow midstory was probably much more prevalent on the floodplains of the Colorado system than cottonwood ever was, and was much more prevalent historically than it is today because it has been severely invaded and replaced along many stretches by tamarisk. This midstory is populated by a diverse avifauna, including several species that thrive in the interface between mesquite and the creosote bush-dominated bajadas (Black-tailed Gnatcatcher, Crissal Thrasher, and Verdin). Of the species that depend on the midstory habitat layer, the Bell’s Vireo and the endangered Southwestern Willow Flycatcher are the key species of management priority. In some instances, both species have shifted their habitat use to tamarisk out of necessity, and the presence of the Southwestern Willow Flycatcher in tamarisk complicates native habitat restoration planning and strategy. Lucy’s Warblers are cavity nesters; therefore they require mature stands of mesquite large enough and old enough to have opened up some cavities. Older-aged mesquite stands are also more susceptible to mistletoe infection, thus enhancing their value to mistletoe-berry-feeding Phainopeplas. While Yellow-billed Cuckoos prefer to forage in cottonwood canopy, they are known mostly to nest in willow, making integrated management of overstory and midstory along the same floodplain stretch critical to the maintenance of the species.

The herbaceous understory is home to Abert’s Towhee, and in Pahranagat Valley, to the Pahranagat Valley montane vole. Various species make use of the features of the channels of the Colorado system, including Spotted Sandpipers, Great Blue Herons, foraging Common Nighthawks, and various species of foraging bats.

The rarity and frequent isolation of lotic aquatic habitats within the Mojave Desert Ecoregion speaks to their significant value for aquatic-dependent species of conservation priority. As in other Nevada key habitats, the isolation and the unique characteristics of individual river and stream systems has resulted in a high level of endemism and adaptation in the distribution of species assemblages within those systems. Pahranagat Valley, the Oasis Valley/Amargosa River flow system, the Virgin and the Muddy rivers all contain individual species assemblages with endemic species of global significance and uniqueness. As such, these habitats are critically important for the conservation and persistence of the component species of their aquatic biota.

Although severely altered from historic conditions by the development of large dams and associated water delivery infrastructure which have permanently altered the physical and dynamic attributes of its aquatic habitats, the Colorado River still maintains important relict populations of mainstem endemic fishes and the reach of the river in Nevada, below Lake Mohave, has a critical role and value in the conservation and recovery of those fishes as one of the few remaining riverine mainstem habitats in the lower Colorado River basin. It provides connectivity to adult populations of both razorback sucker and bonytail in Lake Havasu downstream, refugia to maintain adult fish populations and their genetic resources, and opportunities for research into potential recovery strategies for these altered habitats. Potential exists in Nevada and associated areas of Arizona and California to develop functional backwater habitats within the river's historic floodplain which may have a valuable future role in these species' recovery.

Key Elements of Warm Desert Riparian of Importance to Wildlife

Terrestrial Species

COTTONWOOD OVERSTORY/WILLOW MID-STORY

Scott's Oriole
Yellow-billed Cuckoo
western red bat

HERBACEOUS UNDERSTORY

Pahranagat Valley Montane Vole

WILLOW/MESQUITE/TAMARISK

Loggerhead Shrike
Bell's Vireo
Southwestern Willow Flycatcher
Virginia's Warbler
western brush lizard
mule deer

DUFF/LITTER/DOWNED WOOD

ring-necked snake
Southwest blackhead snake
western threadsnake
Western red-tailed skink

CUT BANKS

Bank Swallow

OPEN FLOODPLAIN

Western Burrowing Owl
bighorn sheep

OPEN AIR OVER WATER FORAGING

Common Nighthawk
Allen's big-eared bat
cave myotis
spotted bat

Aquatic Species

RIVERS

Colorado River

bonytail
razorback sucker
flannelmouth sucker

Virgin River

Virgin River chub
woundfin
flannelmouth sucker
Virgin spinedace
relict leopard frog

Muddy River

Moapa dace
Moapa White River springfish
Virgin River chub
Moapa speckled dace
southwestern toad

STREAMS

Oasis Valley/Amargosa River

Amargosa toad
Oasis Valley speckled dace

Pahranagat Valley

Pahranagat roundtail chub
Pahranagat speckled dace

Existing Environment

Land Uses

- Urban/suburban development
- Agriculture
- Livestock grazing
- Hydroelectric power production
- Irrigation diversion
- Flood Control
- Motorized Recreation

- Non-motorized Recreation
- Wood products extraction (mesquite)
- Species Harvest

Historic and Current Conditions

Almost all of the historic riparian habitats of the mainstem Colorado River as it passes through Nevada have been lost due to the construction of Hoover and Davis dams. What little natural Colorado River floodplain that remains along the Nevada stretch occurs between Davis Dam and the Fort Mohave Indian Reservation. Much of that floodplain has been significantly modified by agriculture and urban development around the city of Laughlin. The remaining habitat has been severely invaded by tamarisk and disconnected from natural floodplain maintenance processes because of altered river flows and channelization. The Virgin and Muddy rivers, Meadow Valley Wash, and the Pahranagat River all have significant stretches of natural riparian vegetation left, but most stretches of these streams have also been severely invaded by tamarisk. Along the Virgin River through Mesquite, much of the floodplain was initially converted to agriculture, but is now undergoing conversion to urban/suburban development, including casinos, residences, and golf courses.

All aquatic habitat systems within this key habitat type have been altered or modified to some degree from historic conditions through actions such as channelization, regulation of flows or diversion of flows for agriculture, recreational and urban development, and the introduction of non-native aquatic species. The level of this alteration ranges from severe (e.g., on the Colorado River below Davis Dam where river flows are highly regulated and confined between constructed dike structures) to relatively minor (e.g., in areas of the Lower Virgin River and Meadow Valley Wash where highly variable, unregulated flows maintain a semblance of natural channel and floodplain characteristics). Seasonal dewatering of certain stream and river reaches occurs in most years on the Virgin River and lower Meadow Valley Wash as a result of land use changes and legal diversion of flows for agriculture.

Problems Facing the Species and Habitats

Urban and suburban development on floodplains is currently resulting in a rapid loss of native wildlife habitat in Warm Desert Riparian habitats. Tamarisk has invaded most areas of these systems, reducing the distribution of native plant communities. More recently, occurrence of the invasive tamarisk leaf beetle (*Diorhabda elongata*), which has moved into riparian habitats on the Virgin and Muddy Rivers and Meadow Valley Wash after releases in adjoining states, has resulted in patchy but widespread defoliation of these monoculture tamarisk stands. As these large areas of tamarisk are lost in the future, this could result in an increased occurrence of even less desirable invasive plant species and at least a short term decline in existing riparian cover in the absence of an effective program for large-scale re-vegetation using desirable native plant species. Understory and vertical vegetative structure are lacking along some stretches of the Colorado River system.

Aquatic habitats in this key habitat type are particularly affected by the presence of large areas of tamarisk monoculture, resulting in increased channel stability that is interrupting normal geomorphic processes from high flow events that would normally maintain aquatic habitat variability and quality. Most aquatic habitat systems also contain introduced and invasive non-native fishes, amphibians and/or crayfish, which are significant stressors on species of conservation concern through competition and predation. Fragmentation of aquatic habitats through agricultural diversions and seasonal dewatering, channelization, regulation of flows, and direct alteration of aquatic habitats through development and construction activities, are critical problems across this key habitat type, in that they affect natural geomorphic processes and negatively alter aquatic habitat characteristics, especially for early life stages of native fishes. Proposed large-scale projects to develop surface water and groundwater resources that include infrastructure to export water outside of the source basin or drainage, have significant potential to negatively affect aquatic habitats through alteration of hydrologic processes or reduction of source and in-channel base flows on the Virgin and Muddy rivers, and within other isolated aquatic systems dependent on local and carbonate aquifer groundwater sources.

Predicted Climate Change Effects

Warm Desert Riparian vegetation was identified in three regions – Mojave, Clover, and Tonopah – with 84% of it occurring in the Mojave region and 15% of it in the Tonopah region. Our analysis indicated that 85 to 100% of Warm Desert Riparian vegetation was currently in the early or mid-closed classes – indicative of conditions one to 19 years after flooding. Only in the Mojave region was any Warm Desert Riparian vegetation classified in any of the later characteristic classes that would indicate closed canopies of either willow/mesquite or gallery cottonwood. Fifty-year projections predicted that 100% of all Warm Desert Riparian in the Mojave and Tonopah regions would transition to uncharacteristic classes with or without climate change. Most of the transition was to "desertified" (incised channel) and did not necessarily mean that functional wildlife habitat would disappear immediately. Up to 25% of the BpS would be invaded by exotic forbs and/or exotic trees (tamarisk); the rest would be incised with varying amounts of native vegetation present. The cause is not specifically related to climate change, but is more indicative of generally unstable floodplains influenced by the processes described in the previous section. While functional wildlife habitat might persist on larger floodplains with incision through the first 50 years, the long-term implications of desertification coupled with exotic forb/tree invasion are not encouraging.

Large areas of the upper Colorado River basin are anticipated to see moderate to substantive increases in precipitation in the next 50 years with much of this occurring in the winter period as increased total snowfall. While this benefit to downstream aquatic habitats may be somewhat mitigated by expected temperature rise with resultant earlier onset of spring runoff events, the management of total net flows in the highly regulated Colorado River system should minimize resultant effects on Colorado River aquatic habitats downstream of Davis Dam, although the potential thermal effects from average air temperature rise and modified reservoir storage patterns are largely unknown. Potential climate change effects on tributary river and stream habitats including the Virgin and Muddy Rivers and Meadow Valley Wash are less well understood, largely because of the uncertainty at a more local scale of available precipitation models. In general, systems partially or largely dependent on local snowpack runoff to maintain spring and early summer base flows such as the Virgin River and Meadow Valley Wash may be affected by earlier onset of spring runoff events and resultant lower base flows in the late spring and summer periods. Most available models also predict increased summer monsoonal storm events and a temporal shift of those events to earlier in the summer period, potentially resulting in higher stochastisity of flows compared to recent historical periods, with a net effect of more frequent channel and floodplain-modifying flow events.

Possible Wildlife Responses To Climate Change

Cottonwood Overstory/Willow Midstory Species

Scott's Oriole
Yellow-billed Cuckoo
western red bat

It is likely that the species guild most impacted by the predicted transitions would continue to be those associated with cottonwood overstory/willow midstory. If Warm Desert Riparian floodplains cannot be stabilized long enough to facilitate the regeneration and maturation of cottonwood and willow to suitable age, Yellow-billed Cuckoos, Scott's Orioles, western red bats, and other cottonwood associated birds and bats would have difficulty maintaining viable populations in the region.

In 169 Warm Desert Riparian survey points, no Scott's Orioles were ever observed during Nevada Bird Count surveys over the 10-year implementation period, casting significant doubt on the importance of Warm Desert Riparian to Scott's Oriole conservation in Nevada. Yellow-billed Cuckoos are encountered at such low densities as to require specially-designed single-species survey to monitor effectively.

Willow/Mesquite/Tamarisk Species

Loggerhead Shrike
Bell's Vireo
Southwestern Willow Flycatcher
Virginia's Warbler
western brush lizard

The six vertebrate species in this group have a long history of coping with transition of willow to mesquite to tamarisk in this region. The species most likely to be affected over the next 50 years would be any that could not transition themselves from willow to either mesquite or tamarisk. Of these five, all have demonstrated adaptability to shift to replacement types as long as structural habitat elements such as crown density are sufficient to hide nests from predators. GBBO reported that Bell's Vireo appeared generally neutral to tamarisk invasion until tamarisk cover exceeded 90%, above which the species tended to be absent, suggesting that monotypic stands of tamarisk might reduce Bell's Vireo populations through its range in Nevada (Nevada Comprehensive Bird Conservation Plan 2010). Southwestern Willow Flycatchers also seem to value the added parameter of saturated soils around their nest sites (perhaps the elevated humidity protects their nestlings from the harsh desert temperatures or wet soils deter certain terrestrial predators). Because desertification results in the lowering of water tables away from standing midstory trees and the surrounding soils can no longer stand saturated through a nesting cycle, Southwestern Willow Flycatchers could be targeted for differential impacts of the predicted transitions over the next 50 years. Without action, the 50 years following 2022 could be even more detrimental to this group.

The GBBO Report was unable to predict population response for Bell's Vireo or Loggerhead Shrike even though it had workable sample sizes of observations because the desertified classes of Warm Desert Riparian were not mapped in LANDFIRE; therefore, relative densities could not be computed for those classes and the species' tolerance for desertification and exotic invasion was not very well understood and could only be inferred from very sparse data (with respect to exotic forb invasion only). Southwestern Willow Flycatcher was not analyzed in the GBBO Report because of inadequate sample size, and Virginia's Warbler had no detections in Warm Desert Riparian survey points during the 10-year implementation period.

Herbaceous Understory Species

Pahranagat Valley Montane Vole

One species, the Pahranagat Valley montane vole, a lowland remnant subspecies long isolated from its source populations which retreated upslope with climate change post-Pleistocene, is particularly associated with meadow vegetation in the Warm Desert Riparian BpS. Should the extensive degree of desertification predicted by the 50-year modeling result in the draining of the floodplains where this species occurs to the extent that meadows could no longer be maintained naturally (and were no longer sustained by irrigation), the Pahranagat Valley montane vole could be negatively impacted and brought to increased conservation risk over the next 50 years. Its lack of connectivity to source populations that could provide replacement and sustain the evolutionary processes that have allowed this subspecies to stay in place for centuries would make maintenance of the species particularly challenging.

Duff/Litter/Downed Wood Species

ring-necked snake
Southwest blackhead snake
western threadsnake
Western red-tailed skink

Four reptiles are placed in a habitat guild associated with leaf litter and downed wood that accumulates on the riparian thicket floor, particularly under mature cottonwood/willow. Accumulated vegetative material provides escape cover and retains moisture that assists these reptiles in thermoregulation against the hot, arid climate. Should the transition from cottonwood/willow to mesquite/tamarisk create a significant change in the quantity or nature of vegetative litter on the floodplain that results in decreased capacity to provide for those needs, these four reptiles could be expected to be impacted by the changes predicted over the next 50 years. For instance, a loss of mature cottonwood could result in a loss of source for peeled bark and larger-diameter limbs that typically shed off dying or dead trees. Downed limbs from mesquite would be smaller and less numerous than those from cottonwood or black willow. Broad-diameter leaves such as fall from cottonwood or sycamore would be replaced by the smaller pinnate leaves of mesquite or the tiny scaled “needles” of tamarisk. These shifts in quantity and quality might be expected to be less effective at retaining microsite moisture and providing adequate escape cover, ultimately resulting in loss of habitat suitability for these ground-dwelling reptiles.

Other Species

Western Burrowing Owl
Common Nighthawk
Allen’s big-eared bat
cave myotis
spotted bat
bighorn sheep

“Open floodplain” species such as Burrowing Owl and desert bighorn are not expected to be significantly impacted by the predicted transitions. Burrowing Owls are adapted to persist in disturbed habitats as long as an adequate prey source (small mammals, reptiles, and large arthropods) is available. Bighorns were added to this discussion mostly from a standpoint of watering at streamside in certain occupied landscapes. Otherwise, bighorns spend the majority of their time in upland habitats. Unless the desertification of riparian vegetation significantly impacts the availability of the insects they feed on, Bank Swallows are expected to be facilitated by increased bank-cutting and incision. Other open-channel-over-water foragers such as Common Nighthawks and the bats are not expected to be impacted significantly by vegetation change, unless there is a negative impact on certain moths or other large flying arthropods particularly favored by any of these species, relationships and preferences that are currently very poorly known.

Aquatic species – Colorado River

Bonytail
Razorback sucker
Flannelmouth sucker

The native fish species endemic to the main stem Colorado River system in Nevada exist in the highly altered habitats of Lakes Mead and Mohave and the Colorado River downstream of Davis Dam. Potential climate change effects to reservoir habitats and associated priority species are addressed in that chapter of this plan. Because little change in operational characteristics can be predicted for Lake Mohave which regulates discharge to the Colorado River downstream, no substantive impacts from climate change are projected for bonytail, razorback sucker and flannelmouth sucker within that river reach. To the extent that lower storage elevations in Lake Mohave could increase seasonal water temperatures discharging to the river, some minor benefits could accrue to flannelmouth and razorback sucker through elevated temperature regimes during the spring through early summer spawning period, but such effects are difficult to predict with any certainty because river flow and temperature characteristics are dictated to such a large degree by independent water delivery requirements.

Aquatic species – Virgin River

Virgin River chub
Woundfin
Flannelmouth sucker
Virgin spinedace
Relict leopard frog

Increased stochasticity in summer flow events and temporal shifts in precipitation patterns potentially reducing late spring and fall base flows would likely be detrimental to priority native fish species dependent on deeper run and pool habits, e.g. Virgin River chub and flannelmouth sucker. Although woundfin superficially might benefit from altered main stem river flow characteristics such as more frequent channel modifying events which may tend to shift available habitats towards sandy run braided channels, this must be balanced against the potential of decreased base flows during critical late summer periods, increasing the time period when resident fishes of all species would be exposed to critical thermal maxima. Relict leopard frogs primarily utilize floodplain based wetland and seep/spring habitats, and projected trends for desertification of these associated off-channel habitats suggest negative effects to frog populations within the watershed.

Aquatic species – Muddy River

Moapa dace
Moapa White River springfish
Virgin River chub
Moapa speckled dace
Arizona toad

Because base flow conditions for much of the Muddy River system are highly dependent on discharge from regional spring complexes tied to carbonate aquifer systems, little effect can be predicted at least through 2022 to priority aquatic species that can be attributed to specific climate change scenarios for precipitation and temperature, independent from anthropogenic impacts from groundwater and surface water development.

Aquatic species – Medlow Valley Wash

Meadow Valley Wash desert sucker
Meadow Valley Wash speckled dace

Much like the Virgin River system, increased stochasticity in summer flow events and temporal shifts in precipitation patterns potentially reducing seasonal base flows would likely be detrimental to these priority aquatic species through substantive but unpredictable changes in physical habitat distribution and quality and increased thermal loading during critical low flow periods; as for the Virgin River, the high uncertainty in predictive models makes qualitative assessments of effect difficult if not impossible.

Aquatic species – Pahranagat Valley, Oasis Valley and Amargosa River

Pahranagat roundtail chub
Pahranagat speckled dace
Amargosa toad
Oasis Valley speckled dace

Both Pahranagat and Oasis Valley stream habitats are, like the Muddy River closely tied to regional spring systems associated with carbonate province geology to support base flows, and as such are likely to show relatively minor effects from climate change in the near term independent of effects from groundwater development and other anthropogenic impacts. For Oasis Valley and Amargosa River species in particular, most predictive models suggest an increased potential for summer monsoonal precipitation patterns which could increase and extend base flow conditions for associated stream habitats, but also could increase the frequency of stochastic rain events with increased potential for flood events, channel scouring and channelization. Given the high uncertainty of most predictive models, net effects to these species are likely to be neutral through 2022.

Priority Research Needs

- Factors limiting distribution of aquatic species in apparently suitable aquatic habitats in the Muddy River system
- Thermal characteristics of low base flows and availability of low-flow thermal refugia in the Virgin River
- Effective methods for control and eradication of invasive aquatic species
- Population viability of Pahranagat Valley montane vole
- Status and distribution of western red bat
- Distribution and habitat requirements of the southwestern toad
- Habitat restoration needs of the relict leopard frog within its historic but unoccupied range on the Virgin and Muddy rivers
- Occurrence and habitat preferences for ring-necked snake, Southwest blackhead snake, western threadsnake, and Western red-tailed skink
- Impacts of exotic vegetation invasion on habitat suitability for bats and reptiles

Conservation Strategy

Goal: Healthy, self-sustaining wildlife populations in diverse native plant communities on functional floodplains; thriving mature cottonwood overstory with healthy prospect of regeneration; willow and mesquite midstory under cottonwood or overstory where cottonwood is absent; arrested spread of tamarisk into intact native vegetation; thriving herbaceous understory.

Objective: Increase the linear extent of native riparian habitat in recovery on the floodplains of Mojave rivers and streams by 15% by 2022.

("in recovery" – native willows, mesquite, cottonwoods established by restoration treatment post-flood-event tracking toward stand maturity)

Action: With local working groups and in cooperation with landowners, convert tamarisk-invaded riparian habitats to native trees and shrubs through tamarisk control and native revegetation efforts at a rate conducive to no-net-loss of Southwestern Willow Flycatcher nesting pairs over any five-year period.

Action: : Restore cottonwood and Goodding willow overstory and coyote willow mid-story through sapling planting and the restoration of natural channel-scouring processes in all sites after all flood events.

Action: Through extension services and management incentives, encourage landowners to apply livestock grazing prescriptions in balance with the ability of the native riparian vegetation to regenerate and maintain itself.

Action: Retard the spread of invasive weeds and grasses into unaffected understories; restore invaded areas through weed control and revegetation.

Action: Assess the condition of montane riparian habitats in the Mojave region and apply appropriate restoration management where necessary. Manage montane riparian habitats for multi-storied vertical vegetation structure to maximize species diversity.

Objective: Maintain 50 breeding pairs of Southwestern Willow Flycatchers in suitable habitat through 2022.

("50 breeding pairs" based on a statewide population estimate of 90 birds (Nevada Comprehensive Bird Conservation Plan 2010).

Action: Continue to pursue conservation protection for designated critical Southwestern Willow Flycatcher habitat.

Action: Continue intensive inventory and nest monitoring project throughout Southwestern Willow Flycatcher range in Nevada.

Objective: Maintain five occupied Yellow-billed Cuckoo "territories" through 2022.

"Occupied territory" – a site producing Yellow-billed Cuckoo response to taped call playback surveys during the breeding season.

Action: Inventory potential Yellow-billed Cuckoo habitats and assess them for habitat suitability. Apply remedial restoration aimed at supplementing/replacing cottonwood overstory and establishing willow mid-story at depleted sites.

Objective: Maintain other warm desert riparian birds of conservation priority at stable or increasing trend in suitable habitats through 2022.

("other birds" include Loggerhead Shrike, Bell's Vireo, Virginia Warbler, Scott's Oriole, Western Burrowing Owl, and Common Nighthawk.)

("stable or increasing trend" – as measured by the Nevada Bird Count and/or supplementary monitoring transects or by USGS Breeding Bird Survey analysis appropriate to the Nevada Mojave Desert.)

Action: Continue partner-based funding for the Nevada Bird Count.

Action: Continue to pursue volunteer staffing of all USGS Breeding Bird Survey routes in Nevada.

Action: Adopt the nightjar (Common Nighthawk) survey protocol developed by Partners In Flight as implemented by the PIF Western Working Group. Share data and participate in both local and regional population trend analysis.

Objective: Maintain Pahranagat Valley montane vole populations at detectable levels through 2022.

("detectable levels" – as measured by routine live trapping annually or at scheduled intervals not to exceed five years.)

Action: Document range and distribution, develop a population estimate and perform population viability analysis for the Pahranagat Valley montane vole.

Action: Direct targeted private lands assistance funding and technical support to landowners to secure community-based habitat conservation for the Pahrangat Valley montane vole within its range.

Objective: Maintain populations of warm desert riparian bats at detectable levels through 2022.

("detectable levels" – as measured by routine ANABAT or mist-netting monitoring protocols annually or at scheduled intervals not to exceed five years.)

Action: Develop random-plot ANABAT monitoring networks with differential objectives for monitoring summer residency and migration using presence/absence occupancy analysis to establish status and trend statewide for bats of conservation priority.

Action: Determine occurrence and habitat functionality for western red bat, Allen's big-eared bat, cave myotis, and spotted bat in Warm Desert Riparian habitats. Determine through targeted research the consequences of transition from native to exotic vegetation on occurrence and habitat suitability.

Objective: Maintain populations of warm desert riparian reptiles at detectable levels through 2022.

("detectable levels" – as measured by visual or pit-trapping protocols as yet undeveloped annually or at scheduled intervals not to exceed five years.)

Action: Develop monitoring protocols for warm desert riparian reptiles of conservation priority with the intent of generating target detectability (occupancy) rates for the purpose of setting future conservation objectives.

Action: Determine occurrence and habitat functionality for for ring-necked snake, Southwest blackhead snake, western threadsnake, and Western red-tailed skink in warm desert riparian habitats. Determine through targeted research the consequences of transition from native to exotic vegetation on occurrence and habitat suitability.

Goal: Fully-functioning aquatic habitat ecosystems that support diverse natural species assemblages; maintenance of natural floodplain function with dynamic interaction of riparian and aquatic habitats within constraints of human need and existing infrastructure development; reduced impacts on aquatic habitats from invasive plant and animal species.

Objective: Increase total linear extent of fully functioning floodplain aquatic habitat on Mojave rivers and streams by 2022.

Action: Pursue implementation of floodplain maintenance and restoration actions through the Virgin River HCRP and associated recovery implementation program

Action: Pursue development and implementation of coordinated river channel and floodplain management strategies for the Amargosa River in Oasis Valley in cooperation with Nye County, BLM and other private and public cooperators.

Action: Identify and implement opportunities for restoration or creation of at least 40 acres of connected and isolated backwaters for Colorado River endemic fish species within historic floodplain below Davis Dam in Nevada through 2022.

Action: Maximize the extent of connectivity in Mojave tributary river lotic habitats through maintenance of flows and by prioritizing the location of fish movement barriers to isolate invasive species to the downstream extent practicable.

Action: Identify and implement strategies to maintain minimum low-flow period base flows on the Virgin River to limit exposure of priority aquatic species to extended periods above thermal maxima and/or provide thermal refuge habitat.

Objective: Maintain healthy populations of aquatic Species of Conservation Priority at stable or increasing trend.

Action: Implement private landowner cooperative agreements to restore or maintain aquatic habitats in Pahranagat and Oasis Valleys for priority aquatic species, including implementation of the Pahranagat Valley Programmatic Safe Harbor Agreement, development of Candidate Conservation Agreements with Assurances and utilization of Landowner Incentive Program opportunities.

Action: Implement cooperative strategies and management plans for native aquatic species of concern in Oasis Valley through implementation of the Amargosa Toad Conservation Agreement and Strategy.

Action: Develop a cooperative management strategy with USBR, USFWS and State of Arizona for Colorado River native fishes below Davis Dam, including cooperative implementation of the Lower Colorado River MSCP and the Rangewide Conservation Agreement and Strategy for Flannelmouth Sucker.

Action: Continue implementation of the Pahranagat Valley Recovery Implementation Team process for Federally listed and associated aquatic species.

Action: Support full implementation of the Virgin River HCRP and Muddy River Recovery Implementation Program (RIT)

Action: Evaluate potential for entrainment of native aquatic species of concern in water diversions on the Virgin River and implement strategies to reduce fish loss

Action: Continue cooperative efforts with the states of Utah and Arizona to implement control and eradication of red shiners in the mainstem Virgin River

Action: Implement cooperative conservation strategies for relict leopard frog identified in the Relict Leopard Frog Conservation Agreement and Strategy.

Action: Complete and implement the Relict Leopard Frog Programmatic CCAA to support conservation actions for relict leopard frog on non-Federal lands in Clark County.

Action: Identify opportunities to establish additional relict leopard frog populations within historic range in the Virgin and Muddy river drainages on public and private lands and pursue population establishments using the CCAA and other available tools.

Action: Implement the Razorback Sucker and Bonytail Programmatic SHA in Clark County to establish additional refuge and grow-out pond facilties for those species.

Action: Actively pursue strategies for control and removal of nuisance aquatic species including nonnative crayfish, aquarium fish species, carp, tilapia and red shiner.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Private	43
Bureau of Reclamation	21
Bureau of Land Management	11
Tribal	4
Open Water	18
Other	3

Existing partnerships, plans, and programs

Recovery Implementation Teams (RITs)
- Muddy River
- Pahranagat Valley
- Meadow Valley Wash
- Virgin River
- Colorado River Fishes

Habitat Conservation Plans
- Clark County MSHCP
- Lower Colorado River MSCP
- Virgin River HCRP
- Southeast Lincoln County MSHCP

Conservation Agreements and Strategies
- Amargosa Toad
- Relict Leopard Frog
- Spring Mountains National Recreation Area

Federal & State Agencies
- U.S. Fish and Wildlife Service
- National Park Service
- Bureau of Land Management
- U.S. Geological Survey (Biological Resources Division)
- U.S. Forest Service
- U.S. Bureau of Reclamation
- Natural Resources Conservation Service & Conservation Districts
- Nevada Department of Wildlife
- Nevada Division of Forestry

Conservation Organizations

- The Nature Conservancy
- National Audubon Society/Red Rock Audubon Society

Bird Conservation Initiatives

- Partners In Flight
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight &Nevada Bird Conservation Plan
- North American Waterbird Conservation Plan
- Intermountain West Waterbird Conservation Plan

Other Key Partners

- University of Nevada (UNLV)
- Intermountain West Joint Venture and State Steering Committee

Focal Areas

Amargosa Desert	Lower Meadow Valley Wash
Bitter Spring Valley	Moapa Valley East
Bullfrog Hills	Moapa Valley West
Lake Mead	Oasis Valley
Las Vegas Wash	Virgin River Valley

Also:	Amargosa River	Muddy River
	Colorado River	Virgin River

Springs & Springbrooks

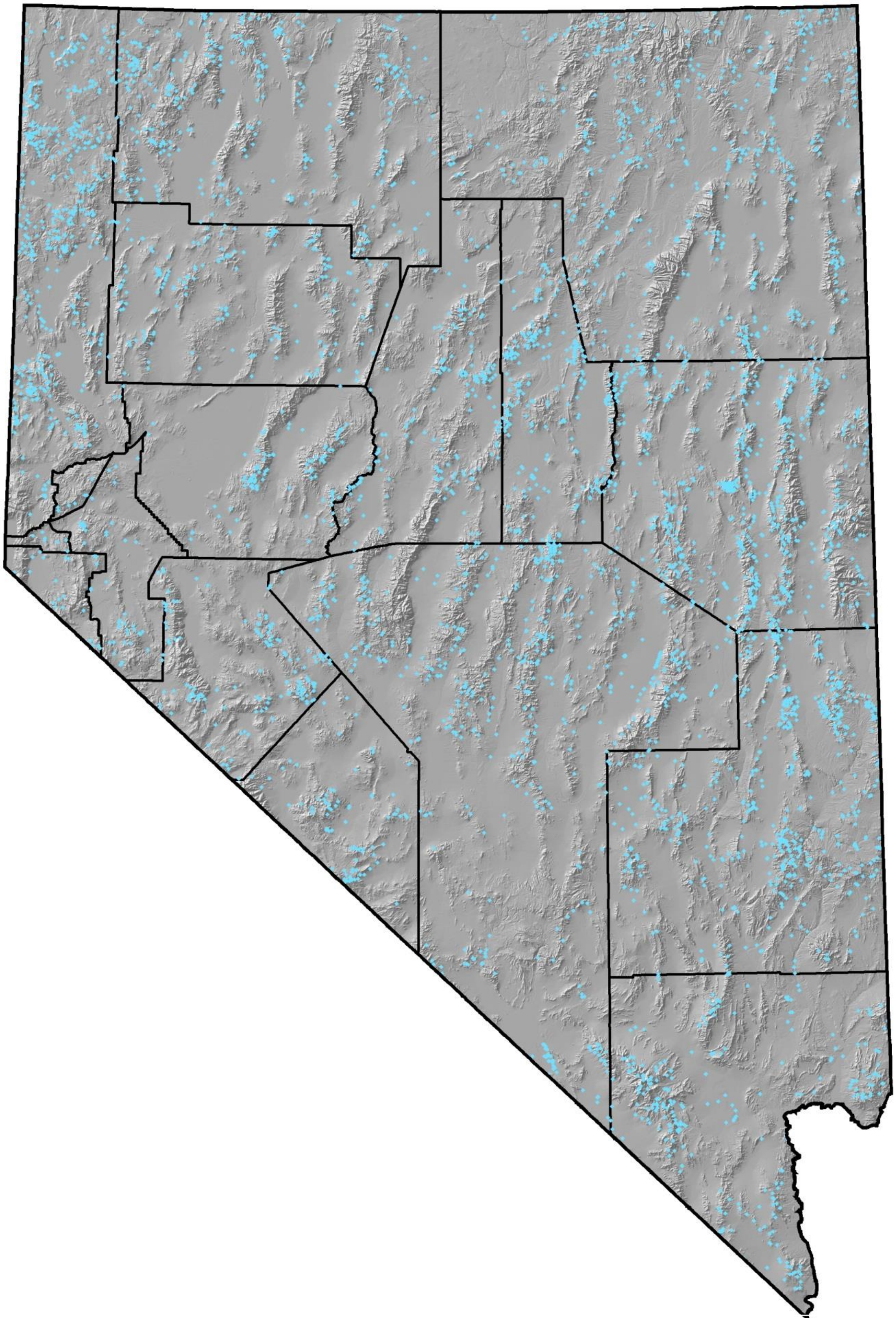


Figure 17: Distribution of Springs and Springbrooks in Nevada.

KEY HABITAT: SPRINGS AND SPRINGBROOKS

Things to Know….

- Nevada has the most springs in the U.S. with over 4,000 springs.
- Springs and springbrooks provide habitat for 165 of Nevada's 173 endemic species, which includes fish and aquatic invertebrates.
- This habitat is primarily threatened by water diversion, excessive livestock grazing, groundwater depletion, recreation, mining (de-watering activities), and establishment of non-native species.
- Springs tied to carbonate aquifer systems will likely experience little effects from climate change; however, non-carbonate systems are more dependent on recharge and seasonal flow which can be greatly affected by climate change.

Ecoregions

Southwest ReGAP 2005

Great Basin	3,123 springs
Columbia Plateau	814 springs
Mojave	467 springs
Sierra Nevada	2 springs
Total	4,406 springs

Ecological Systems

SWReGAP Ecological Systems

A012 Ephemeral springs/springbrooks
A013 Cold perennial springs/springbrooks
A014 Thermal (warm) and hot perennial springs/springbrooks

*No TNC biophysical settings were developed

Key Habitat Description

Nevada has the most known springs of any state in the U.S. Over 4,000 springs of various temperatures and flow have been mapped. A spring occurs where deep or shallow ground water flows from bedrock or natural fill onto the land surface and forms surface flow or a body of water. Springbrooks are the areas of flowing water linked to the spring source. Springs are generally divided into three main categories: cold springs (springs near or below mean annual air temperature), warm or thermal springs (springs 5 to 10°C (40 to 50°F) above mean annual air temperature), and hot springs (springs more than 10°C (50°F) above mean annual air temperature). Over 100 of the known springs in Nevada have surface temperatures 38°C (100°F) or higher. The source and subterranean pathway of water may be local or regional. Thousands of springs occur in a variety of landform settings throughout the state.

In addition to thermal conditions, the characteristics of individual spring and spring brook systems can vary tremendously in terms of flow, water chemistry, and habitats provided for terrestrial and aquatic wildlife species. Many spring systems important to wildlife represent little more than seeps. Even relatively small spring and spring outflows can support important populations of endemic gastropods and other aquatic invertebrates.

Several locations in Nevada also contain individuals or groupings of large, regionally important springs which are in most cases thermal or hot water systems associated with regional aquifer flow systems. Big Warm Spring in Railroad Valley, Nye County, for example, has a recorded discharge varying from 22 to 24 cubic meters per second (780 to 850 cubic feet per second) at 30° to 33° C (86 to 91°F), from a source pool 24 m (80 ft) in diameter (U. S. Fish and Wildlife Service 1997). Similar regional spring discharge areas such as Soldier Meadow, Upper White River Valley, Pahranagat Valley, Ash Meadows, and the Warm Springs area of Clark County support important diverse assemblages of spring-dependent endemic species. These larger (and some smaller) spring systems generally support extensive springbrook outflow habitats, downstream wetland and marsh habitats, and may also contribute significant flow to associated tributary and first order stream and river systems, such as the upper White River and Muddy River.

Value to Wildlife

Gains in scientific knowledge about the contribution of spring habitats to biodiversity and the longevity of "ancient" water supply sources and gains in knowledge regarding the importance of ground water to the springs and the distribution or morphology of underground flow systems have drawn attention to spring conservation and management.

Early studies described many unique fishes endemic to spring and springbrook habitats, and studies since the mid-1980s have described a number of endemic spring-dwelling macroinvertebrates (primarily gastropods and aquatic insects). Other surveys document endemic mammals, amphibians, crustacea, and plants from spring-fed wetlands. Of Nevada's 173 endemic species, 165 are associated with spring-fed habitats (Abele, 2011).

An important aspect of thermal aquatic systems is that fish are able to move within the system to meet their temperature needs; during winter months they can move closer to the spring source to meet thermal maintenance requirements, while using cooler outflow systems during warm weather periods. Springs provide crucial habitat to a significant percentage of Nevada's federally-listed and state protected aquatic species.

In addition to springs' critical role in the survival and conservation of endemic aquatic species, they also play a very important role for other wildlife species. Nevada, which has the lowest annual rainfall in the U.S., has limited surface water resources, particularly during drought. Springs provide a vital water source between infrequent surface waters, providing water availability and food resources for a wide range of Nevada's wildlife, from bighorn sheep, elk, and deer; to birds and bats. The broad distribution of functional spring and spring outflow systems of all types across Nevada's landscape is an important element in maintaining Nevada's wildlife diversity.

Key Elements of Springs and Springbrooks of Importance to Wildlife

EPHEMERAL SPRINGS

Columbia Spotted Frog (Great Basin pop)
Northern leopard frog

THERMAL (WARM)/HOT SPRINGS AND SPRINGBROOKS

Relict leopard frog
Ash Meadows speckled dace
Relict dace
Warm Springs Amargosa pupfish
Ash Meadows Amargosa pupfish
Meadow Valley speckled dace
Devil's Hole pupfish
Moapa dace

Fish Creek Springs tui chub	Pahrump poolfish
Moapa White River springfish	Moorman White River springfish
Desert dace	Railroad Valley springfish
Hiko White River springfish	White River springfish
Preston White River springfish	

COLD SPRINGS AND SPRINGBROOKS

Big Smoky Valley speckled dace	Big Spring spinedace
Clover Valley speckled dace	Big Smoky Valley tui chub
Independence Valley speckled dace	Diamond Valley speckled dace
Fish Lake Valley tui chub	Railroad Valley tui chub
Monitor Valley speckled dace	Oasis Valley speckled dace
Pahranagat roundtail chub	Pahranagat speckled dace
White River desert sucker	White River speckled dace
White river spinedace	Amargosa toad
Relict leopard frog	Columbia spotted frog (Great Basin pop)
Western toad	Northern leopard frog
Great Plains toad	Smooth juga

Gastropods

Amargosa tryonia	Camp Valley pyrg
Antelope Valley pyrg	Corn Creek pyrg
Ash Meadows pebblesnail	Crystal Spring pyrg
bifid duct pyrg	Distal-gland pyrg
Big Warm Spring pyrg	Dixie Valley pyrg
Blue Point pyrg	Duckwater pyrg
Butterfield pyrg	Duckwater Warm Springs pyrg
Elko pyrg	Oasis Valley pyrg
elongate Cain Spring pyrg	ovate Cain Spring pyrg
elongate Mud Meadows pyrg	Pahranagat pebblesnail
elongate-gland pyrg	Pleasant Valley pyrg
Emigrant pyrg	Point of Rocks tryonia
Fairbanks pyrg	Pyramid Lake pebblesnail
Flag pyrg	Sadas pyrg
flat-topped Steptoe pyrg	small gland Carico pyrg
Fly Ranch pyrg	smooth juga
grated tryonia	southeast Nevada pyrg
Hardy pyrg	southern Duckwater pyrg
Hubbs pyrg	southern Soldier Meadow pyrg
Humboldt pyrg	southern Steptoe pyrg
Kings River pyrg	sportinggoods tryonia
Lake Valley pyrg	Spring Mountains pyrg
Landyes pyrg	squat Mud Meadows pyrg
large gland Carico pyrg	Steptoe hydrobe
Lockes pyrg	sterile basin pyrg
longitudinal gland pyrg	sub-globose Steptoe Ranch pyrg
median-gland Nevada pyrg	transverse gland pyrg
minute tryonia	turban pebblesnail

Moapa pebblesnail
Moapa Valley pyrg
monitor tryonia
neritiform Steptoe Ranch pyrg
northern Soldier Meadow pyrg
northern Steptoe pyrg
northwest Bonneville pyrg
Twentyone Mile pyrg
Upper Thousand Spring pyrg
Vinyards pyrg
Virginia Mountains pebblesnail
White River Valley pyrg
Wongs pyrg

Existing Environment

Habitat Conditions

Like other water-associated habitats, dewatering, diversion works, channelization, and invasion of non-native plants and animals have altered springs (Bureau of Land Management 2001). The introduction of non-native aquatic organisms into spring and springbrook habitats, particularly the establishment of thermally tolerant invasive species into warm and thermal spring systems, has significantly impacted resident endemic species through competition and predation and represents the single greatest threat to a number of the aquatic species of conservation priority. The establishment of emergent invasive plant species such as cattails and *Phragmites* in spring pools and outflows has severely modified and altered some spring habitat and flow characteristics. In some basins, groundwater pumping has been found to depress spring flow and a small number of larger regional springs have demonstrated temporary or permanent dewatering as a result of groundwater development. Field studies have documented degraded habitat conditions, declines in sensitive plant and animal populations, and species extinctions. Similar to other wetlands, springs are intensively used. Livestock, wild horses, and diversions were the predominant disturbances found in a study of 511 northern Nevada springs (Sada, 2001), and disturbance from trampling can be particularly detrimental to water quality and spring pool and springbrook habitat characteristics.

A substantial number of springs on private and public lands have been historically altered by piping of outflows or the construction of spring head boxes. These practices eliminate or significantly modify spring pool and spring outflow habitats for wildlife and can eliminate important source water locations for use by resident wildlife species. More recent efforts to provide wildlife access to these modified spring systems are important, but have focused on terrestrial species needs with limited attention to restoring natural spring system functions to support spring-dependent endemic aquatic communities. There are concerns that current protection and management attention is not sufficient to maintain endemic species, sustain spring ecological site integrity and long-term water production. Scorecard 2006 lists over 69 sites throughout the state that house globally rare and endemic species in areas that are currently in need of management due to urgent threats. Of these 69 sites, approximately 75% are springs (NNHP, 2006). Springs, particularly larger regional complexes, are also popular centers of human recreational activities. Although recreation can be managed to minimize effects on spring ecosystems in most cases, uncontrolled or poorly planned recreational use can have significant negative effects on spring habitats and biota.

Land Uses

- Groundwater development
- Road development
- Development and diversion of flow
- Motorized and non-motorized recreation

- Livestock grazing
- Urban/suburban and industrial development

Problems Facing the Species and Habitats

Spring and springbrook habitats and associated species are primarily threatened by water diversion, excessive livestock grazing, groundwater depletion, recreation, mining (de-watering activities), and establishment of non-native species. Detrimental introduced plant species include saltcedar, purple loosestrife, Canada thistle, knapweed, and tall whitetop. Detrimental introduced animals include mosquito fish, goldfish, mollies, bullfrogs, crayfish, a snail, and several introduced sport fish (rainbow trout, largemouth bass). Improper grazing by cattle can also cause significant damage by eliminating riparian vegetation and/or trampling (leading to topsoil loss during rainfall and snowmelt events, and to "sealing" of the spring in areas with high clay content). The same impacts can also occur with wild horse and burro use. Species such as elk can also impact springs; in areas where large populations exist, their impacts can be similar to those of livestock.

The development of springs and seeps, a common historic practice for livestock watering, domestic water supply and other reasons, is a significant concern because of the critical importance of spring resources as a source of surface water for terrestrial wildlife and also because many springs and seeps of all sizes support unique endemic aquatic biota. The development and modification of spring sources and source pools directly alters or removes important aquatic habitats, modifications can limit access to remaining surface water by wildlife, and the diversion of water away from outflow channels modifies and can reduce or destroy associated riparian and wetland habitat, as well as limit or eliminate flowing water habitat for springbrook-associated endemic species. Although not directly related to the development and alteration of spring systems, groundwater development has been a historic stressor on Nevada wildlife and habitats and continues to represent a significant ongoing threat. As demonstrated in areas such as Ash Meadows and Pahrump Valley in southern Nevada, excessive groundwater withdrawal can alter groundwater flow and recharge patterns, resulting in loss of connectivity between groundwater and surface water habitats and concurrent impacts to vegetative communities and surface flow of ground water from springs and seeps. These impacts are often not well understood, and can vary considerably depending on local geology, the characteristics of groundwater development actions, and the nature of the groundwater resources being accessed.

Springs are also susceptible to pollution because they are often supplied by shallow aquifers that can easily become polluted if spilled chemicals percolate from the surface through rock fractures or joints. Some potential sources are refuse disposal, hazardous material, injection fields, oil and gas development, and ungulate fecal material. Recreational use impacts include bleach and soap added to the springs, soil compaction, removal of vegetation and resulting erosion from camping along the edges of springs, and manipulation of spring flow from installing tubs and water diversions.

Predicted Climate Change Effects

The potential effect of climate change on groundwater recharge and subsequent surface discharge will, to a great extent, be dependent on the underlying geology. Great Basin hydrogeology is complex and impacts on individual spring systems will be dependent not only on their specific correlation to carbonate or non-carbonate regional groundwater aquifers, but also the physical location and elevation of individual sites within a given basin system or watershed. Generally speaking, large (often thermal) springs and spring complexes tied to regional or intermediate carbonate aquifer flow systems are likely to show minimal effects from projected changes in seasonal precipitation patterns and increasing air temperatures over the next 20 to 30 years. Big

Warm Spring in Railroad Valley, Hot Creek in White River Valley, and Ash Spring in Pahranagat Valley are examples of these types of spring systems which are characterized by their connection to deep regional flow systems encompassing multiple valley basins and discharge of “old” water at warmer temperatures because of the depth of the connection to groundwater. Where effects can be associated with these regional springs, it primarily will be expected in the springbrook components of the systems where increased air temperatures and transpiration could have potential effects on springbrook length, total wetted area, and thermal characteristics of the springbrooks affecting habitat suitability for certain species.

The majority of springs in Nevada, however, are not directly associated with deep carbonate regional flow systems and are more dependent on local recharge and short-term changes in precipitation and runoff patterns. Both valley bottom springs associated with non-carbonate groundwater aquifers, and intermediate and higher elevation (mountain block) springs are generally characterized by discharge of “younger” (often less than 60 years old) water and are highly dependent on groundwater recharge from winter precipitation in local mountain systems to maintain flows, and even under existing climatic conditions can show inter-annual variability in discharge greater than that typically shown by carbonate based regional springs. Because these spring systems are much more dependent on relatively shallow groundwater flow and local recharge, anticipated effects from climate change will be substantially greater. Warming air temperatures will affect not only springbrook characteristics but have the potential to modify precipitation characteristics; increased snowline elevations, early spring onset, and temporal changes in precipitation timing all have the potential to alter groundwater recharge characteristics with corollary effects on individual spring total discharge and increased interannual variability in flow.

Possible Wildlife Responses to Climate Change

Because spring systems are biodiversity hotspots in an otherwise arid landscape, and because of historic isolation from other aquatic systems and often unique physical and chemical characteristics, they support an outsized proportion of Nevada’s locally endemic biota. Larger regional spring systems tied to deep carbonate aquifer systems are likely to show the least short-term effects from climate change through 2025 because of the relative stability of these groundwater sources. Substantive effects in many cases may be limited to changes in total springbrook length, total wetted area and aquatic habitat characteristics and quality in extended springbrooks associated with changes in thermal characteristics. Thus, effects on resident biota may be largely limited to species dependent on lower springbrook habitats that are unable to fully utilize warmer water temperatures favored by thermal endemic species. In spring systems associated with non-carbonate and local recharge zones, anticipated species-related effects beginning within the next 20 years could be more substantive but will be highly variable between sites depending on local and often unpredictable changes in precipitation patterns and shallow groundwater recharge rates. In general, negative effects on springbrook habitats will be similar to that for larger regional springs but will likely extend upstream closer to spring sources with the higher potential in these springs for reduced total discharge due to changes in local conditions. The net result for resident endemic aquatic species is a reduction in total available habitat within these systems. Of potentially greater concern in local recharge spring systems is a potential increase in seasonal and interannual variability of spring discharge. Certain species, such as endemic gastropods, are highly dependent on habitat stability and increases in discharge variability will likely restrict the available range of habitat for these species in some systems and could potentially lead to local extinctions at some sites.

Priority Research Needs

- Impacts of groundwater withdrawals on a regional scale
- Groundwater interbasin connections and recharge intervals

- Determine status of Great Plains toad at springs in Lincoln County
- Invertebrate adaptability to alterations in water level, water chemistry, and other tolerance parameters
- Effective methods for control and removal of invasive and non-native animal species, particularly in larger regional spring systems where flow and physical characteristics make conventional physical and chemical control methods impractical
- Effective methods for restoration and reconstruction of fully-functioning spring habitats

Conservation Strategy

Goal: Springs and springbrook habitats functioning naturally within the natural fluctuation inherent to the spring type (recognizing that regional springs are inherently much more stable than those supported by local aquifers).

Objective: A measurable increase in the number of springs and springbrooks functioning naturally and supporting the natural ecological community expected for each spring by 2022.

Action: Continue to assess the current functional status of Nevada's springs.

Action: Establish a working group to contribute expertise, pool data, and develop and implement a management plan for Nevada springs. (Springs already addressed under other management plans will be noted in the plan)

Action: Map springs and digitally document their historical condition, desired condition, and restoration potential.

Action: Prioritize management and restoration activities by spring.

Action: Restore degraded springs and associated riparian areas. Identify factors affecting site potential and adjust land uses to allow for natural spring and springbrook recovery.

Action: Acquire and maintain water rights holdings for the benefit of wildlife use.

Action: Work with the Desert Fish Habitat Partnership and National Fish Habitat Action Partnership to identify and implement restoration projects for spring systems supporting priority DFHP fish species and spring-associated strategic goals of the DFHP Framework Action Plan.

Action: Maintain the ecological structure and function of spring habitats by stabilizing discharge and springbrook morphology.

Action: Manage springs and their riparian areas as a unit using guidelines appropriate to these systems, such as those used to manage wetland areas and riparian zones.

Action: Identify locations where passage barriers fragment springbrook habitats for priority fish species and implement corrective actions where appropriate.

Action: Manage for a minimal standard of proper functioning condition (PFC) for springs and associated riparian areas on public lands, utilizing existing guidance and standards for spring and springbrook ecosystems.

Action: Incorporate standardized biological assessment as an adaptive management feedback mechanism to assess spring management effectiveness.

Action: Work with landowners to manage spring habitats, including providing information about optimum habitat, invasive species, and available grant and other funding opportunities.

Action: Establish conservation easements, Safe Harbors Agreements, and Candidate Conservation Agreements with willing landowners, MOAs, or acquire key habitats or water rights from willing sellers.

Objective: No net loss of spring/springbrook-dependent Species of Conservation Priority.

Action: Develop a public outreach program utilizing interpretive programs, watchable wildlife opportunities, and other educational approaches regarding the importance of springs in partnership with BLM, USFWS, NPS and other cooperators.

Action: Actively pursue strategies to prevent introduction of nuisance aquatic plant and animal species, including educational campaigns targeted at pet stores, nurseries, classrooms, researchers, biologists, and others.

Action: Support actions by land management partners and local governments to control invasive and noxious plants and weeds, especially saltcedar and emergent plant species which directly impact functioning of spring and springbrook aquatic habitats.

Action: Continue implementation of existing recovery and conservation programs for spring and springbrook dependent Species of Conservation Priority including endemic amphibians, and species occurring within the upper White River, Pahranagat Valley, Muddy River, Railroad Valley, Independence Valley, and Clover Valley systems.

Action: Organize cooperative conservation implementation working groups to develop and implement conservation strategies for Desert Dace and Ash Meadows endemic fishes.

Action: Develop and implement a regional Conservation Agreement and Strategy for isolated spring systems and dependent Species of Conservation Priority including land management partners and adjacent state responsible entities.

Action: Encourage research on innovative methods and strategies for the control and removal of invasive and nuisance animal species from spring and springbrook systems, particularly crayfish and thermally dependent non-native fishes.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	63.1
Private	18.8
U.S. Forest Service	12.2
U.S. Fish & Wildlife Service	2.4
U.S. Department of Defense	1.3
Other	2.2

Existing Partnerships, Plans, and Programs

Species Teams, Recovery Plans, and Conservation Agreements

- White River Recovery Implementation Team
- Railroad Valley Recovery Implementation Team
- Big Spring Spinedace Recovery Implementation Team
- Muddy River Recovery Implementation Program
- Pahrump Poolfish Recovery Implementation Team
- Soldier Meadow Recovery Working Group
- Pahranagat Valley Recovery Implementation Team

Conservation Agreements and Strategies

- Amargosa Toad Conservation Agreement and Strategy
- Amargosa Toad Management Plan
- Relict Leopard Frog Conservation Agreement and Strategy
- Northeast Nevada Columbia Spotted Frog Conservation Agreement and Strategy
- Toiyabe Columbia Spotted Frog Conservation Agreement and Strategy
- Draft Tui Chub Species Management Plan
- Big Spring Spinedace Recovery Plan and Recovery Implementation Plans
- Recovery Plan for the Endangered Species of Clover and Independence Valleys
- Railroad Valley Springfish Recovery Plan
- Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley
- Pahranagat Valley Native Fishes Management Plan
- Recovery Plan for the Pahrump Killifish
- White River Native Fishes Management Plan
- Indian Spring Candidate Conservation Agreement with Assurances
- Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada
- Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem
- Recovery Plan for the Rare Species of Soldier Meadows
- Spring Mountains National Recreation Area Conservation Agreement

Federal & State Agencies

- Bureau of Land Management
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service/Conservation Districts
- Bureau of Reclamation
- National Park Service
- U.S. Geological Survey (Biological Resources Division)
- Nevada Natural Heritage Program
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Agriculture

Conservation Organizations

- The Nature Conservancy
- Sierra Club
- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society

Partner-based Restoration and Management Efforts

- Muddy River Regional Environmental Impact Alleviation Committee (MRREIAC)
- Desert Fish Habitat Partnership
- Muddy River Project (TNC)
- Oasis Valley Project (TNC)

Habitat Conservation Plans

- Clark County Multiple Species Habitat Conservation Plan
- Spring Mountain Ranch Habitat Conservation Plan
- Nevada Springs Conservation Plan (2011)

Other Key Partners

- Counties
- Tribes
  - Duckwater Shoshone Tribe
  - Moapa Band of Paiutes
- University of Nevada (UNR, UNLV, Cooperative Extension)
- Desert Research Institute
- Southern Nevada Water Authority

Focal Areas

Amargosa Desert
Big Smoky Valley
Black Rock Desert Wash
El Dorado Mountain
Fish Lake Valley
Goshute Mountains
Independence Valley
Lower Meadow Valley Wash
Moapa Valley East
Monitor Valley
Oasis Valley
Pahranagat Valley
Railroad Valley
Roberts Creek Mountains
Spring Mountains
Spring Valley
White River Valley

Also: Condor Canyon

Mesquite Bosques & Desert Washes

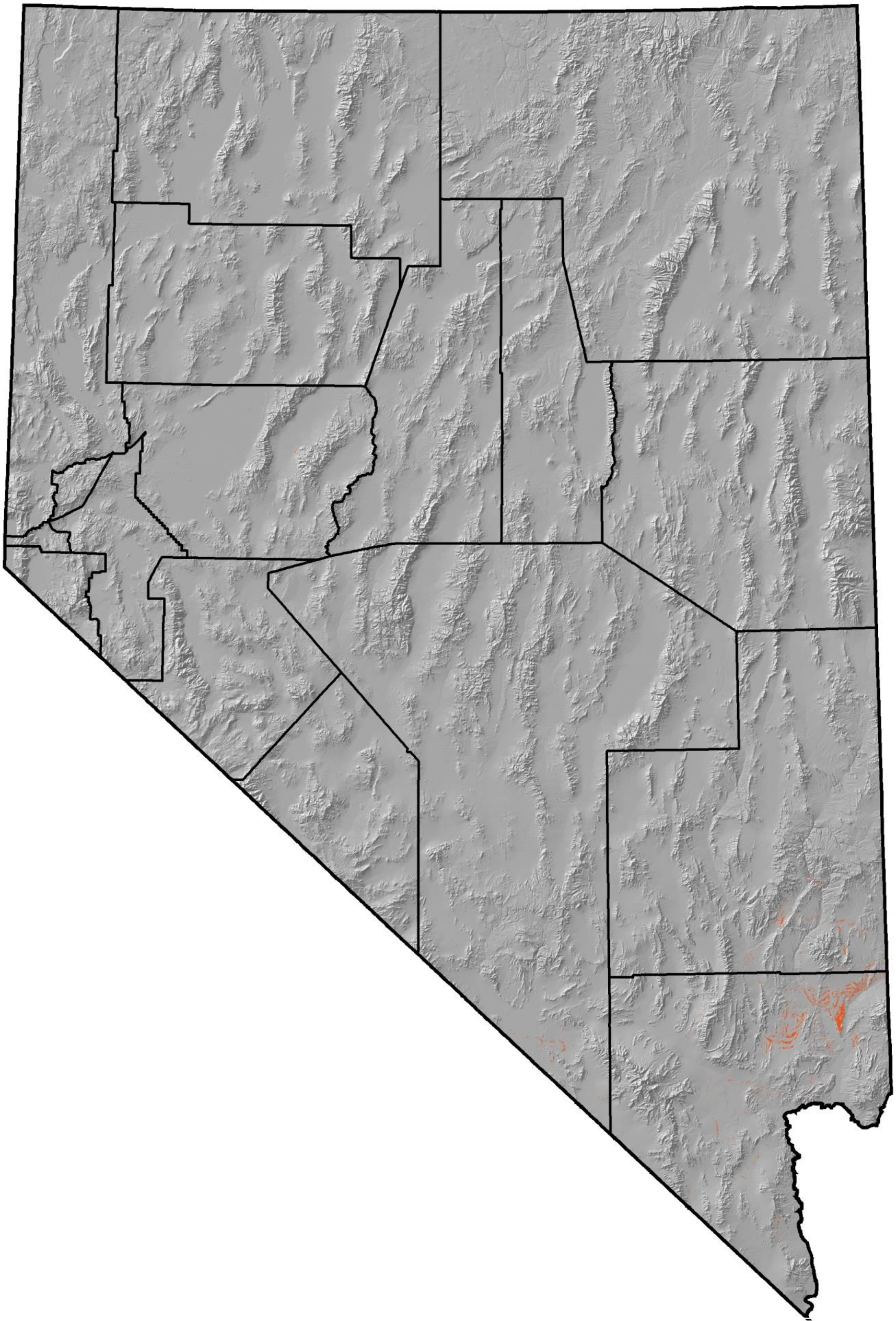


Figure 18: Distribution of Mequite Bosques and Desert Washes in Nevada.

KEY HABITAT: MESQUITE BOSQUES AND DESERT WASHES

Things to Know….

- Mesquite bosques and desert washes are found in areas with deep soils and shallow water tables along washes and riparian areas in the Mojave Desert.
- This habitat contributes significantly to local wildlife diversity; key priority species include Bell's Vireo, desert pocket mouse, and Great Plains toad.
- Habitat threats include OHV use and invasive plants, such as salt cedar, both resulting in loss of native vegetation.
- Desert washes (but not necessarily mesquite bosques) were predicted to increase in extent over the next 50 years with climate change

Ecoregions

Southwest ReGAP 2005

Mojave	31,206 hectares	77,111 acres
Great Basin	159 hectares	393 acres
Total	31,359 hectares	77,504 acres

Ecological Systems

TNC Biophysical Setting	*SWReGAP Ecological Systems*
Washes………………………………	SO20 North American Warm Desert Wash
**	SO98 North American Warm Desert Riparian Mesquite Bosque

**SO98 was included in TNC Biophysical Setting "Warm Desert Riparian" in another chapter

Key Habitat Description

Mesquite bosques and desert washes are found in areas with deep soils and shallow water tables along washes and riparian areas, and also in isolated patches in low-lying areas such as the edges of dry lake beds. In riparian corridors, mature mesquite bosques often occupy the higher terraces above the 100-year event floodplain. The characteristic plant species in this habitat type are honey mesquite and catclaw. Honey mesquite is distributed throughout Clark County and parts of southern Lincoln and Nye counties, while catclaw acacia is generally distributed along washes, particularly in extreme southern Nevada. Distribution of the two species tends to be linear, as in wash systems, although mesquite also occurs as isolated clumps or in small woodlands associated with sandy dunes. Both habitat types can be infected with mistletoe, which enhances their value to fruit-eating birds.

The growth form of mesquite varies from thorny, impenetrable thickets to large trees that can reach heights as great as 30 feet with stems approaching 3 feet in diameter. Catclaw forms thorny thickets along linear wash systems as well as isolated clumps across the desert. Other plant species occurring in these habitats include screwbean mesquite, quailbush, desert willow, seepwillow, and wolfberry. Common grasses found in mesquite habitat include Great Basin wildrye, saltgrass, and alkali sacaton. Desert mistletoe is a hemi-parasitic plant that uses mesquite and catclaw as its host.

Value to Wildlife

Like Mojave Rivers and Streams, Mesquite Bosques and Desert Washes contribute significantly to the wildlife diversity of the Mojave Desert to an inordinate scale when their acreage is compared to the surrounding bajada vegetation. Not only are there species in the bosques and washes that would not appear in the Mojave Desert if these habitats were not there, but the juxtaposition of bosques and washes to the upland matrix also defines the upland territories of highest productivity and desirability to upland species. In effect, the wildlife activity of the Mojave Desert is concentrated around the bosques and washes. While none of the species listed in the assemblages below are solely dependent on this key habitat, the statewide population maintenance of all of them is greatly enhanced by it. Of the birds that use bosques and washes, Yellow-breasted Chat, Verdin, Lucy's Warbler, Crissal Thrasher, and Phainopepla almost certainly would not be found in the desert landscape without the presence of mesquite. The sandy soils deposited and maintained by desert washes are critical to the needs and distribution of the desert pocket mouse. Nevada represents the northernmost extent of the species' range, and the Nevada subspecies, *Chaetodipus penicillatus sobrinus*, has been demonstrated to be geographically isolated from any other populations of the species, making conservation in Nevada particularly critical (Marshall, et al., 2004).

Although desert washes do not generally contain permanent water, with the rare exception of occasional spring and seep features, they serve as seasonal conduits of higher soil moisture and occasional surface flow which can often leave remaining ephemeral pools and sinks well after the end of precipitation events. Because of this they are particularly important for species such as Great Plains toad which utilize ephemeral and temporary breeding pools, and can serve as valuable corridors for the movement of terrestrial wildlife, including endemic amphibians. As such they may have an important role in amphibian distribution and metapopulation maintenance within these arid landscapes. Moreover, desert washes in the Mojave Desert are preferred habitat for desert tortoise because they use wash slopes to excavate burrows, especially underneath hardpan benches, and to forage on the more productive herbaceous vegetation associated with greater soil moisture.

Key Elements of Mesquite Bosques and Desert Washes Habitat Important to Wildlife

MESQUITE – nesting structure, protection from predators, foraging, thermal cover

- Loggerhead Shrike
- Bendire's Thrasher
- LeConte's Thrasher
- Arizona Bell's Vireo
- Brewer's Sparrow
- desert night lizard
- western brush lizard

SANDY BOTTOMS – burrowing

- Burrowing Owl
- desert pocket mouse
- desert iguana
- desert tortoise
- long-nosed leopard lizard
- desert horned lizard
- rosy boa

shovelnose snake
spotted leaf-nosed snake

GRASSY MESIC – foraging, burrowing
western threadsnake
ring-necked snake
western red-tailed skink
Panamint alligator lizard

GRAVELLY BOTTOMS – nesting substrate
Common Nighthawk
Arizona toad
Great Plains toad
Amargosa toad

ROCKS AND CANYONS – foraging, burrowing, protection from predators, movement corridors
bighorn sheep
Gila monster
western banded gecko
chuckwalla
Great Basin collared lizard

Existing Environment

Land Uses

- Urban/suburban development
- Industrial development
- Motorized recreation
- Sand and gravel extraction
- Wood products extraction
- Military mission
- Road development
- Utility rights-of-way
- Species harvest

Habitat Conditions

Mesquite bosques and catclaw washes are being lost at an unprecedented rate to urban and suburban development and the attendant activities of mesquite woodcutting, sand and gravel mining, and human-caused wildfire. Mesquite bosques have been significantly invaded by tamarisk in many areas, and the native understory has been replaced by red brome and cheatgrass. Considering the importance of the contribution this key habitat type makes to its landscape in terms of wildlife diversity, this is likely one of the state’s most endangered habitats.

Problems Facing the Species and Habitats

Maintenance of the habitat type itself in the face of burgeoning urban and suburban development is the most difficult problem facing mesquite bosques and catclaw washes. Off-road vehicular activity can result in serious structural damage to shrubs, stripping them of their value as wildlife cover, and soil disturbance can lead to accelerated erosion. With increased levels of disturbance, the value of these habitats for burrowing species, such as desert tortoise, is diminishing. There is also concern for the viability of the Nevada population of desert pocket mouse (Marshall, et al., 2004) given its limited preference of suitable habitats that has resulted in the fragmentation of local populations.

The U.S. Breeding Bird Survey (BBS) documented a population decline of 50% or greater for Bendire’s Thrasher between 1966 and 1999. The PIF North American Landbird Conservation Plan has identified Bendire’s Thrasher as a Watch List Species in need of Immediate Action in the Mojave Bird Conservation Region due to the combination of significant population decline and restricted distribution. Similarly the BBS documented a population decline of 50% or greater for Brewer’s Sparrow, and while the stewardship responsibility for Brewer’s Sparrow is much greater in the neighboring Great Basin; the Mojave Desert ecoregion provides important wintering habitats for the species.

Predicted Climate Change Effects

Mesquite Bosques

The predicted climate change effects for mesquite habitats in linear warm desert riparian habitats are discussed in the Warm Desert Riparian chapter. It is difficult to predict if playa-edge mesquite bosques will be subject to the same degree and nature of threat from exotic invasive plants as riparian floodplains or not. It does not appear that water quantity will have an impact, but timing of recharge and duration of inundation and percolation might have an impact on the health of these playa-edge bosque habitats with unknown long-term effects.

Desert Washes

Desert washes were predicted to increase in extent over the next 50 years with climate change mostly recipient to conversions of non-carbonate montane riparian systems that will lose their perennial water flow. It is difficult to evaluate the loss of perennial water and conversions to intermittent flow in positive terms.

Taking Prescriptive Action

Prescriptive actions were not specifically developed for mesquite bosques or the Desert Washes BPS as part of the TNC Climate Change Analysis, but prescriptive actions appropriate for mesquite bosques are discussed in the Warm Desert Riparian chapter. Most prescriptive actions germane to desert wash management involve preventing non-carbonate montane riparian and warm desert riparian habitats from losing their perennial flow and converting to desert washes. Although not modeled, actions that can slow the drop of the water table and lengthen the retention of flowing water in perennial streams into desert washes would involve currently-used best management grazing practices (for example, fencing perennial reaches and deploying water gaps), creating low-technology pool and riffles systems, and removing encroaching pinyon and juniper in the narrow floodplain of streams. Desert washes that experienced bank incisions and loss of fine sediment can sometimes be reclaimed using shallow, handmade rock dams and strategically placed woody debris.

Priority Research Needs

- Hydrologic dynamics of playa-edge bosques and strategies for long-term maintenance
- Quantification of desert wash/bosque influence on distribution patterns of upland desert priority species
- Distribution and habitat relationships models for western brush lizard
- Distribution, habitat relationships models, and decline factors for Bendire's Thrasher
- Population viability analysis for desert pocket mouse
- Population status and ecology of gila monster
- Distribution and population status of Panamint alligator lizard
- Habitat relationships models for all reptiles of Conservation Priority
- Importance of desert washes to endemic amphibian movement and metapopulation maintenance

Conservation Strategy

Goal: Thriving self sustaining wildlife populations in healthy plant communities on stable substrates resistant to destructive erosion and sustained by intermittent flow and/or high water tables; thriving mature mesquite overstory sustained by high water tables; vigorous catclaw acacia stands on corridors where high water tables are absent.

Objective: Expand protected status for Mesquite Bosque and Desert Wash ecological systems by 2022.

"expand protected status" – moving acreage from "multiple use" (public) or "unmanaged" (private) designations to any of several "protected" designations on public lands or through easements or purchases for private lands.

Action: Protect mesquite and catclaw habitats from urban and suburban development through mitigation achieved under the Clark County Multiple Species Habitat Conservation Plan (MSHCP).

Action: Support the designation of new Areas of Critical Environmental Concern (ACEC's) as proposed in discussions regarding the BLM's Las Vegas District RMP revision.

Action: Secure mesquite bosque protection through conservation easements on private lands or purchases from willing sellers.

Action: Increase protection from illegal cutting of mesquite through increased enforcement and education.

Action: Increase protection for desert washes from off-highway vehicle damage through the appropriate land use planning processes.

Action: Increase protection for desert washes from gravel mining in critical habitats for priority species.

Action: Develop restoration and mitigation techniques to reduce the long-term net impact of gravel mining on desert washes in critical areas for priority species.

Objective: Stabilize declining trends for Bendire's Thrasher, LeConte's Thrasher, and Loggerhead Shrike by 2022.

"declining trends" as projected by USGS Breeding Bird Survey analysis and measured by BBS or Nevada Bird Count surveys conducted at regular intervals not to exceed five years.

Action: Develop predictive models and inventory occupied habitat for declining species for the purpose of developing reliable population estimates and meaningful conservation objectives.

Action: Restore and maintain mesquite bosque habitats to suitable habitat conditions for these species as described in the Nevada Comprehensive Bird Conservation Plan.

Objective: Maintain Bell's Vireo, Virginia's Warbler, and Western Burrowing Owl populations at stable or increasing trend through 2022.

"stable or increasing trend" as projected by USGS Breeding Bird Survey analysis and measured by BBS or Nevada Bird Count surveys conducted at regular intervals not to exceed five years.

Action: Monitor and mitigate losses of Burrowing Owl habitat to urban/suburban development through appropriate land management planning processes.

Action: Monitor and mitigate local impacts of OHV recreation on burrowing owl nesting areas.

Action: Restore and maintain mesquite bosque habitats to suitable habitat conditions for these species as described in the Nevada Comprehensive Bird Conservation Plan.

Objective: Maintain bighorn sheep populations at stable or increasing trend through 2022.

Action: Continue to provide reliable water sources for bighorn sheep in desert washes using applied water development techniques where warranted.

Objective: Maintain desert pocket mouse populations at self-sustaining levels with connectivity and gene flow occurring between population centers through 2022.

"self-sustaining levels" – populations that maintain themselves on the landscape without artificial assistance or manipulation with no danger of extirpation at local scales.

"connectivity and gene flow" – one of the stated conservation challenges for desert pocket mouse is that the specificity of their habitat preferences creates patchy, disjunct distributions on the landscape that can become isolated with minimum or no connectivity to adjacent populations, effectively restricting free genetic exchange and risking deterioration in population health, vigor, and persistence through genetic stagnation.

Action: Perform population viability and connectivity analysis for desert pocket mouse and apply appropriate conservation actions based on results.

Objective: Maintain current value of mesquite bosque and desert wash systems as movement and breeding habitats associated with priority amphibian species through 2022.

"current value" is defined as clear, utilizable corridors without impediments to free movement up and down washes and maintenance of hydrological function and protection of hibernacula beds

Action: Determine the importance of desert washes and mesquite bosques on local distribution of priority toad species in relation to surrounding upland vegetation and perennial water sources.

Action: Determine the importance of desert wash habitats for amphibian movement and metapopulation maintenance, and provision of ephemeral amphibian breeding habitat.

Action: Incorporate recommendations for these habitats into existing amphibian species conservation and land use planning efforts to protect movement corridors and amphibian metapopulation dynamics.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	100

Existing partnerships, plans, and programs

- Clark County Multiple Species Habitat Conservation Plan
- Southern Nevada Mesquite Woodland Habitat Management Plan

Federal & State Agencies

- Bureau of Land Management
- National Park Service
- Nevada Department of Wildlife
- Nevada Division of Forestry

Conservation Organizations

- The Nature Conservancy
- National Audubon Society/Lahontan Audubon Society (Important Bird Areas Program)
- Sierra Club

Bird Initiatives

- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight
- Nevada Bird Conservation Plan

Amphibian Initiatives

- Amargosa Toad Conservation Agreement and Strategy

Other Key Partners

- Intermountain West Joint Venture
- Great Basin Bird Observatory
- University of Nevada (UNR, UNLV)

Focal Areas

Amargosa Desert
Bitter Spring Valley
Las Vegas Valley
Las Vegas Wash
Lower Meadow Valley Wash
Moapa Valley –East
Moapa Valley-West
Virgin River Valley

Amargosa Toad Photo Courtesy of NV IBA Program

Marshes

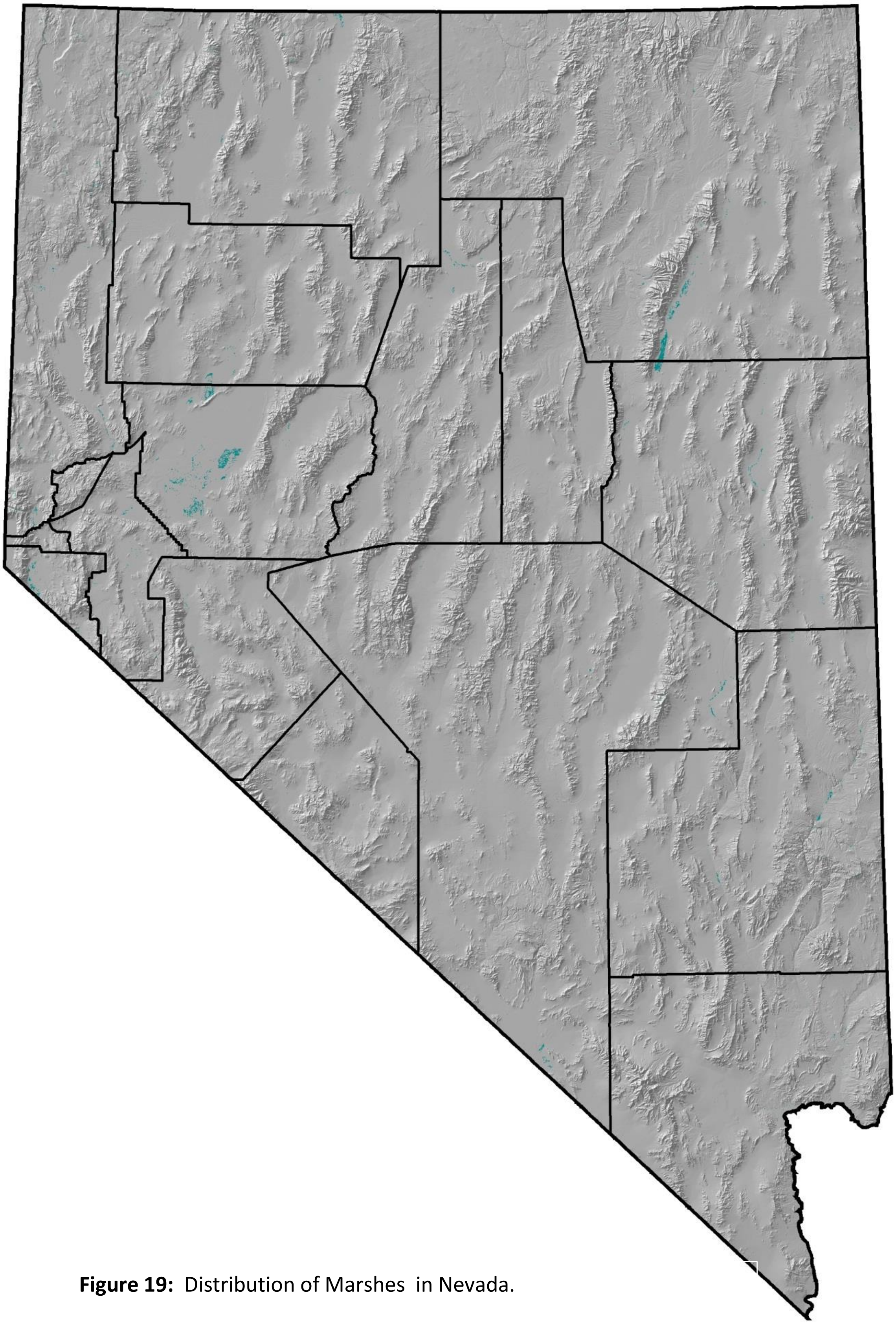


Figure 19: Distribution of Marshes in Nevada.

KEY HABITAT: MARSHES

Things to Know….

- Marshes occur on soils that remain moist through a portion of the year; some hold water year-round, and some marshes are wet seasonally.
- Marshes are important to thousands of migrating birds and about 56 breeding bird species. Key priority species include Canvasback, Redhead, and White-faced Ibis.
- The greatest habitat threat is disturbances to the water regime and impaired water quality.
- The most important managed marshes will be affected by climate change as it impacts the ability of watermasters to deliver water in timely fashion and quantity to all enfranchised users.

Ecoregions

Southwest ReGAP 2005

Great Basin	33,297 hectares	82,277 acres
Columbia Plateau	5,780 hectares	14,284 acres
Mojave	1,767 hectares	4,367 acres
Sierra Nevada	48 hectares	119 acres
Total	40,892 hectares	101,047 acres

Ecological Systems*

S100 North American Arid West Emergent Marsh

*No TNC Biophysical Settings were developed

Key Habitat Description

Marshes occur on soils that remain moist or saturated through a significant portion of the year. The length and extent of soil saturation or inundation influences the type of vegetation a site will express; those marshes which hold surface water on a year-round or extended seasonal basis will support different plant communities and biotic species assemblages than those dominated by only moist soils or ephemeral surface moisture. A single site often carries the seed and root stocks to exhibit all the possible plant communities. Water salinity also influences the particular community of plants present. Under long-term inundation, cattails and pondweed prefer fresher regimes, hardstem bulrush, alkali bulrush and sago pondweed favor middle ranges, and salt-tolerant plants such as wigeon grass inhabit the saltier regimes. “Moist soils” refers to substrates inundated for very short intervals often repeated and receded several times over the course of a growing season. Plants inhabiting moist soils include Baltic rush, smartweeds, sedges, and spikerushes.

Value to Wildlife

Marshes are among Nevada’s most diverse and prolific wildlife habitats. The occurrence of marshes on the landscape is critical to both breeding and migratory needs of many species of birds. Nevada’s marshes have astonishing capability to produce abundant populations of macroinvertebrates that fuel food chains, either through being consumed first by fishes or directly by shorebirds and small water birds. Hundreds of thousands of shorebirds migrate north and south through Nevada annually and are dependent on the availability of these high-volume invertebrate stocks to restore the fat reserves critical to reaching their breeding and wintering destinations. Arctic-breeding shorebirds that depend on Nevada marshes for transitory fuel include Long-billed Dowitcher (up to 100,000), Western Sandpiper (60,000+), and Red-necked Phalarope (30,000+) (NDOW, 1986-2010). These transient shorebird flocks are followed by migratory Peregrine Falcons en route between their wintering and Arctic breeding grounds. Up to 12,000 Tundra Swans and 30,000 Snow Geese also winter or migrate through Nevada. The importance of Nevada to migratory birds was recognized in 1988 with the designation of the Lahontan Valley Wetlands (Churchill County) as a Site of Hemispheric Importance in the Western Hemispheric Shorebird Reserve Network (Myers, et al., 1987).

In addition, Nevada's marshes are home to 56 breeding bird species, including 5,000-10,000 nesting pairs of White-faced Ibis (Earnst et al., 1998), 5,000+ pairs of American Avocets, 1,000+ pairs of Black-necked Stilts (Neel and Henry, 1997), and hundreds of pairs each of Great Blue Herons, Snowy Egrets, Great Egrets, and Black-crowned Night-Herons. Up to 6,500 pairs of American White Pelicans from the breeding colony on Anaho Island in Pyramid Lake depend on the fish in the shallow wetland waters of Lahontan Valley and Humboldt Sink during the peak wet years. Ruby Lakes NWR (Elko and White Pine counties) is one of the most important Canvasback nesting sites in the western United States. Other Species of Conservation Priority include American Bittern, Western Least Bittern, Black Tern and Northern Pintail. Small breeding populations of Yuma Clapper Rail (an endangered species) occur in riverine wetlands within the Colorado River drainage, and a small colony of Tricolored Blackbirds occurs in Carson Valley (Douglas County). When emergent stands of hardstem bulrush and cattail desiccate and cure during the driest drought years, they become naturally infested with populations of voles and other rodents, providing foraging opportunities for a host of predators, notably wintering raptors such as Ferruginous Hawk, Rough-legged Hawk, Northern Harrier, and Prairie Falcon. It is during these years that Short-eared Owl nesting peaks on these dry marsh stands.

An endemic subspecies of montane vole (Pahranagat Valley) occurring in the marshes of the White River Valley deserves special note as it represents a completely isolated remnant population of a species that was more widely distributed and interconnected in the wetter geologic periods following the Pleistocene glaciation. Once connected through more mesic conditions to source populations of montane voles at higher elevations, this valley floor relict is now completely isolated and occurs as much as 100 miles from the next nearest montane vole population. The persistence of the Pahranagat Valley montane vole was confirmed by the research and survey work of Crawford (2010), but the Ash Meadows montane vole was not encountered in the same study and is most likely extinct.

Where marsh habitats contain standing water year-round, they have a particular importance for endemic fish species of conservation concern. This is particularly important where this habitat type occurs in context with areas of open water or flowing stream systems, or where associated spring seeps and groundwater flow provide enhanced water quality and depth on a continual basis. Permanent and ephemeral marshes are a critical landscape feature providing habitat for all life stages of amphibian species. More permanent marsh features are an important component of habitats supporting many resident amphibians for reproduction, recruitment, adult maintenance, and winter hibernacula. Ephemeral and seasonal marsh habitats serve an important role in supporting amphibian movement across arid upland habitat types, providing a connection between core amphibian populations, and certain amphibian species are highly dependent on seasonal availability of these more xeric ephemeral marsh habitats for reproduction and recruitment.

Key Elements of Marshes Habitat Important to Wildlife

MAT NESTERS/OPEN WATER FEEDERS

Black Tern
Canvasback
Redhead

ISLAND NESTERS/PISCATORIAL (fish eating)

American White Pelican

LONE TULE/CATTAIL NESTERS

American Bittern
Western Least Bittern
Yuma Clapper Rail
Short-eared Owl

DRY/WET RESIDUAL VEGETATION NESTER FLOODED GRASS FEEDER

Northern Pintail

FLOODED SHORT GRASS NESTERS (colonial or single)

American Avocet
Long-billed Curlew

FLOODED TALL GRASS NESTERS

Greater Sandhill Crane
Bobolink
Wilson's Phalarope

COLONIAL NESTERS (tule/cattail/willow)

White-faced Ibis
Tricolored Blackbird

DRY/MOIST RESIDUAL GRASS-foraging, burrowing, protection from predators, thermal cover

Pahranagat Valley montane vole

BARREN GROUND NESTERS

Western Snowy Plover
Common Nighthawk

PREY POPULATIONS-feeding on species in this habitat

Peregrine Falcon
Bald Eagle
Ferruginous Hawk
Prairie Falcon

MIGRANTS-foraging on macroinvertebrates

Red-necked Phalarope

Long-billed Dowitcher
Western Sandpiper

MESIC MARSH (permanent/semi-permanent standing water)-aquatic species tied to water source for all of their life history requirements; reproduction, recruitment, adult maintenance, and winter hibernacula for amphibians

Fish Lake Valley tui chub
Independence Valley speckled dace
Independence Valley tui chub
Ash Meadows Amargosa pupfish
Moorman White River springfish
Oasis Valley speckled dace
Pahranagat speckled dace
Railroad Valley springfish
Railroad Valley tui chub
Amargosa toad
Columbia spotted frog (Northeast Nevada and Toiyabe sub-populations)
northern leopard frog

XERIC MARSH (ephemeral/moist soil)-movements of amphibians during wet periods (connect more permanent marshes or other water sources that support amphibian populations)

Amargosa toad
Columbia spotted frog (NE and Toiyabe)
Northern leopard frog
Western toad
Great Plains toad

Existing Environment

Land Uses

- Livestock grazing
- Irrigation diversion
- Non-motorized recreation
- Urban/suburban development
- Industrial development
- Road development
- Waste/hazardous material disposal (mostly historic, but still influential)
- Species harvest

Habitat Conditions

The quality and extent of wetlands in Nevada has been greatly altered and reduced by upstream water diversions. Heavy metal contamination of wetland substrates has occurred from the leaching of crop soils naturally impregnated with elements such as selenium, boron, molybdenum, etc. In addition, historic gold mining activities discharged massive quantities of mercury into Nevada's river systems, most notably the Carson River. These mercury-laden sediments shift during flood events and when exposed, intermittently pose threats to successful reproduction of birds on some of Nevada's most important wetlands. Where water rights have been successfully secured to maintain wetlands, habitat quality is high and a variety of wetland management objectives can be met on a cyclic basis in concert with natural regional climatic cycles. In some limited locations, the abandonment or reversion of lands historically converted for agriculture has allowed restoration of former wetland and marsh habitats, although significant challenges remain because of alterations to flow and drainage patterns and loss of mesic soil types. Where artesian flow wells from abandoned land entry claims have remained operational, such as in Railroad Valley in Nye County, extensive wetland areas have been developed in locations where they were historically absent or only seasonal in extent.

Problems Facing the Species and Habitats

Without the presence of natural surface flow, or groundwater sources conveyed to the surface through spring flows, Nevada's wetlands are difficult to maintain in natural condition. Water delivery is interrupted and reduced, disrupting the emergence and progression of vegetative communities and invertebrate blooms. This in turn reduces the number and diversity of wild animals the marshes are able to support. Waters applied over the soils of many of Nevada's desert floors load up with trace heavy metals and deposit them to wetland substrates where they accumulate over time to sometimes reach effect levels that can disrupt the physiological processes of wetland wildlife, including reproduction, and can even reach toxic levels if not actively managed by flushing (dilution) and drying (which exposes surface salts to wind removal). Reduced water availability results in the reduction of diverse habitats that can be maintained; therefore the myriad of wildlife objectives associated with wetland management cannot be met in a single year. Some of Nevada's historical marshes have been lost completely (Winnemucca Lake), and are not likely to be seen again. Invasive species have made serious inroads into Nevada's marsh communities, both plants (e.g., tamarisk and tall whitetop) and animals (e.g., common carp), and threaten to compromise marsh productivity and species integrity.

Predicted Effects of Climate Change

Precipitation patterns predicted after 2040 indicate regional increases in winter precipitation ranging from zero (western-northwestern) to 25% (northeastern), but a decrease in spring precipitation ranging from zero (extreme northeastern) to 25% (lower west-central, or south ends of Toiyabe and Tonopah regions). Concurrent with regional variation in changing precipitation patterns, all Nevada regions are expected to consistently experience temperature warming. As a result, consistent increases in evapotranspiration (therefore, drought levels) are predicted regardless of precipitation levels, although the northeast corner of Nevada may experience less evapotranspiration than other regions. Specific hypotheses of change advanced in the TNC Report included:

- Longer period of summer and early fall low flows caused by earlier snowmelt
- Greater severe flood variability due to greater frequency of rain-on-snow events
- More effective recharge of aquifers caused by snowmelt and rain entering the soil column and shallow aquifer during the late winter and spring before plant evapotranspiration assumes late spring and summer levels
- Greater buffering of aquifer discharge on carbonate (limestone and dolomite) than non-carbonate geology (most volcanic and metamorphic rocks) due to the higher permeability and longer term storage capacity of carbonate rock than non-carbonate rock

Impacts to the key marshes most important to wildlife in Nevada are very difficult to predict because the dominant water delivery processes (surface *versus* groundwater) and geology interact with periods of snowmelt and evapotranspiration. Overall, marshes located on carbonate geology will be more buffered from climate change as these often depend less on variation in snowmelt and more on deep aquifers.

Much of Nevada's most productive wetland acreage (Lahontan Valley Wetlands, Humboldt WMA, and Mason Valley WMA) occurs on relatively intensively managed properties serviced by managed river systems with reservoir control. As long as current water right demands are met, additional deviations resulting from climate change are not expected to be recognizable beyond the impacts that managing the irrigation projects upstream have already had. It is difficult to predict if earlier runoff events will tax current reservoir capacities or force changes in reservoir operation. The most likely outcome starting 40 years in the future for these managed rivers and wetlands meandering through predominantly non-carbonate geology is that low flows during the growing season would persist for an additional month and greater evapotranspiration would occur. Stillwater National Wildlife Refuge, Carson Lake and Pasture, and Mason Valley WMA are all supported by water rights owned by the state and/or federal agencies. The consistency of the annual wetland output on these properties outside of high-flow years is not expected to change during the next 40 years because of reservoir management and use of senior water rights. Humboldt WMA does not have water rights and is located at the end of the Humboldt watershed, which makes the Humboldt WMA vulnerable to climate change even with the predicted increase in precipitation for northeast Nevada. The cumulative effect of future increased evapotranspiration from Elko County to the Humboldt sink – nearly all non-carbonate rock – will reduce the amount of water reaching the Humboldt WMA.

Three important managed marsh sites occur in the White River system sustained largely by carbonate springs whose deep aquifers contain water with residence times measured in the hundreds to thousands of years – Kirch WMA near Sunnyside in the north White River Valley, Key Pittman WMA in the north Pahranagat Valley, and Pahranagat NWR on the south end of Pahranagat Valley. Water supply for these properties is not expected to be significantly impacted over the next 50 years of climate change because of carbonate geology buffering; however, increases in regional groundwater pumping resultant of urban growth and/or climate change could have significant negative impacts. These properties are smaller than those mentioned above, but are quite important within their local context where wetlands are rare and the uplands in which they occur are quite xeric and harsh. Ash Meadows NWR in Amargosa Valley is another carbonate spring-supported wetland that does have a marsh component. The primary management concern of Ash Meadows is maintenance of endemic fishes in the spring pools. The effect of carbonate geology buffering extends to Ash Meadows equally.

Of perhaps greater concern are smaller, isolated mesic marsh and xeric marsh habitats not associated with larger regional groundwater flow systems either directly or through lentic flow systems. Although the high degree of variability in available seasonal precipitation models challenges specific predictions of effect, generalized predictions of reduced spring precipitation, coupled with an ongoing rise in year-round ambient air temperatures can be anticipated to result in a potential decrease in the extent and seasonal persistence of small mesic and xeric marsh habitats on the landscape, particularly in the lower west-central parts of the state where corollary increases in winter snowpack would not be available to contribute to small marsh habitat spring and summer seasonal persistence, although localized positive effects from increases in mid-late summer monsoonal precipitation patterns may mitigate this effect somewhat in southwestern and south-central Nevada. Further, most predictive models indicate a moderate to substantial (up to 20%) decrease in mid- late summer precipitation across much of northern and west-central Nevada which could directly impact the extent and persistence of small isolated marsh habitats if this is not offset by positive changes in locally important snowpack based runoff.

Overall, Nevada's most important marshes are already managed primarily for wildlife and are supported by water systems that appear to be somewhat inured to the impacts of the next 50 years of climate change. As long as water in Nevada's rivers continues to flow significantly toward the agricultural systems that have been in place for the last 80-100 years, Nevada's protected, managed marshes will continue to have enough water and resources to meet the needs of wildlife, but perhaps at a scale reduced from that of recent history (50 years ago).

Possible Wildlife Responses to Climate Change

As long as current water management regimes are not significantly impacted by shifts in timing and amount of peak runoff, wildlife productivity and distribution is not expected to change significantly from current conditions, although intentions to restore wildlife productivity back to levels of previous recent history will become more and more difficult to realize. Likely departures from that best case scenario will be longer periods of low flows and dry marshes that could reduce the productivity of the aquatic food chains, especially in western and central Nevada. Should timing and quantity of runoff result in significant differences in the way water is deployed in managed marshes, the biggest challenge is likely to be an increased difficulty in creating productive submergent plant communities of desirable species favored by waterfowl and sustaining them through hotter drier summers into the important fall migration period. Invertebrate population abundance, critically important to migratory shorebirds, waterfowl, and resident fishes, may be impacted by timing of water receipt and duration of suitable hydration of managed marsh units (cells, fields). Provision and sustenance of suitable breeding habitat for American Avocets and other breeding shorebirds as well as White-faced Ibis and other colony-nesting marsh birds may become more difficult as water is received earlier in the season, is less-supported by local spring and summer precipitation, and more heavily taxed through evapotranspiration occurring over longer periods of hotter temperatures.

These same forces are expected to also impact the ability to provide permanent aquatic habitats in the marsh lands themselves, rendering fish resources dependent on marshes even more cyclic and dependent on river flows and constant recolonization from rivers and reservoirs than they are currently. Increased stochasticity in fish populations could produce secondary effects on priority fish-eating birds, particularly the American White Pelicans of Anaho Island in Pyramid Lake. Less dependable and abundant fish resources in the shallow-water wetlands of western Nevada could increase predation pressure on the spawning stocks of endangered cui-ui and Lahontan cutthroat trout of Pyramid Lake, particularly at distribution bottlenecks such as Marble Bluff Dam and other impoundments. Spatial decreases in the extent and persistence of both mesic and xeric marshes in mid-summer through fall periods will alter the availability of shallow marginal habitats; frogs and toads may find it increasingly difficult to find hibernacula beds that retain minimum soil moisture parameters to sustain life through dormant periods, and emergence events may become less frequent with shorter viable tadpole development periods that, taken to their extremes, could significantly impact amphibian populations' abilities to replace themselves within minimum required intervals. An additional concern is that loss of small and isolated but persistent marsh habitats may impact amphibian metapopulation dynamics dependent on the availability of these local wetland features for the maintenance of movement corridors, even with the potential increase of summer and fall monsoonal events in some areas of the state which would encourage amphibian movement across the landscape.

Priority Research Needs

- Continue to study the extent and effects of heavy metal contamination on wetland wildlife
- Water management and shorebird migration/staging
- Connectivity between Nevada wetland sites and other sites in the Intermountain West for coordinated regional wetland management to achieve regional bird population objectives

- Monitor changes in runoff dynamics and their effects on the creation and maintenance of productive marsh habitats, including invertebrate population dynamics, submergent and emergent plant community effects
- Updated information regarding seasonal dispersal of American White Pelicans from the Anaho Island colony

Conservation Strategy

Goal: Healthy, self-sustaining wildlife populations in dynamic plant communities adapted to cyclic conditions driven by climatic fluctuations; a functional mosaic of submergent, emergent, and open water marsh types supported by water regimes that are natural or mimic the natural diversity of intermountain systems progressing from dry to fresh to saline to dry.

Objective: No net loss of wetland sites through 2022.

Action: Through the Nevada Wetlands Plan, the Nevada Important Bird Areas Program, and others, prioritize wetland sites in need of more effective conservation and implement a conservation designation program focusing on the most critical sites first.

Action: Use the full array of conservation tools to achieve effective conservation status for Nevada's most critical unprotected wetlands, including conservation easements, interagency agreements, and purchase of lands from willing sellers.

Action: Develop, maintain, and support outreach programs regarding the critical importance of wetland conservation in Nevada for proper hydrologic function of Nevada ecosystems as well as for wildlife conservation.

Action: Work to restore wetlands protection through regulation at the federal level; supplement or restore weakened wetland preservation regulations through legislation and application at the state level.

Objective: No net loss of wetland acreage within the natural fluctuation of 10-year drought cycles through 2022.

Action: Purchase water rights from willing sellers for delivery and application to wetlands.

Action: Oppose and/or negotiate compensation for new proposals to divert water upstream of critical wetland sites.

Action: Cooperatively pursue North American Waterfowl Conservation Act (NAWCA) and other funding for wetlands improvement and restoration in Nevada.

Action: Develop wetlands using urban and suburban waste water with appropriate attention to the management and removal of harmful chemical residues. Incorporate wetland design into urban waste and runoff water treatment technology as standard operating procedure for new or upgraded developments.

Action: Implement area management plans on actively managed wetland sites, including National Wildlife Refuges, State Wildlife Management Areas, and privately owned wetlands (such as gun clubs). Refresh area management plans on a 5-10 year rotation, set goals and objectives, measure implementation success and set adjusted objectives.

Objective: Maintain a 10-year average of 3,000 nesting pairs of White-faced Ibis statewide through 2022.

"10-year average" – marsh-bird-nesting is cyclically tied to 10-year drought patterns; therefore, regularly occurring peaks and lows need to be factored in to the management target computation.

"3,000 nesting pairs" – 2,000 nesting pairs in Lahontan Valley averaged over a 10-year period plus 1,000 nesting pairs scattered over other suitable nesting sites around the state (Humboldt WMA, Humboldt River, Ruby NWR, etc.)

Action: Maintain flooded bulrush/cattail breeding habitat at stable or slightly waning water levels in key wetland units of Carson Lake and Pasture, Stillwater NWR, Humboldt WMA, and Ruby Lakes NWR from May 1 through August 1.

Action: Maintain aerial colony-nesting marsh bird surveys of all known colonies associated with major White-faced Ibis colonies at regular intervals not to exceed five years.

Objective: Maintain 10-year average of breeding adult American White Pelicans using Anaho Island NWR of 8,500 through 2022.

"8,500" – based on 2001-2010 10-year intervals in Stillwater NWR survey results database (USFWS, 2011).

Action: Facilitate the flooding of wetland units at Carson Lake and Pasture and Stillwater NWR in Lahontan Valley over sustained periods of time sufficient to provide forage fish populations for American White Pelicans between March 1 and November 1 annually.

Action: Facilitate the filling of Carson Sink two years out of 10 during peak-flow years.

Action: Facilitate the flooding of wetland units at Humboldt WMA over sustained periods of time sufficient to provide forage fish populations for American White Pelicans between March 1 and November 1 five years out of 10.

Action: Continue annual breeding bird censuses of Anaho Island nesting colony.

Action: Update information regarding seasonal dispersal of American White Pelicans from the Anaho Island colony relative to Pacific Flyway Council population management objectives and concerns.

Objective: Maintain a 10-year average of 5,000 nesting pairs of American Avocets in suitable habitats statewide through 2022.

"5,000 nesting pairs – A population estimate for Lahontan Valley Wetlands (NDOW 1986) that is likely no longer achievable in that locale alone but now projected rangewide across the state to include all major breeding wetlands.

Action: Maintain flooded grasslands at a constant depth of 2-12 inches between April 1 and August 1 as a regular element of annual marsh management on managed marshes.
Action: Initiate breeding shorebird surveys of major managed wetlands conducted annually so that a statewide breeding population is derived.

Objective: Maintain 1,200 breeding Long-billed Curlews (LBCU) rangewide in Nevada through 2022.

"1,200 breeding [birds]" – population estimate from Nevada Comprehensive Bird Conservation Plan (2010)

Action: Maintain areas of demonstrated LBCU nesting preference within narrow fluctuations of water level that do not flood out nests through May 1-July 1 nesting season.

Action: Conduct breeding pair surveys at regular intervals not to exceed five years in areas of LBCU nesting concentration, or statewide as resources permit.

Objective: Maintain a 10-year average of 300 nesting pairs of Black Terns statewide through 2022.

"300 nesting pairs" – the statewide breeding population is estimated at 700 birds in the Nevada Comprehensive Bird Conservation Plan (2010) – 600 birds peak attendance at Ruby Lakes NWR and 100 birds estimated for all other Nevada wetlands.

Action: Implement a coordinated statewide survey and inventory of Black Tern nesting colonies annually through 2022 or until 300 nesting pairs have been found.

Action: Dedicate relatively salt-free water supplies to the maintenance of freshwater marsh communities characterized by spikerush (*Eleocharis* spp.) and arrowleaf pondweed in emergent stands to encourage Black Tern nesting.

Action: Initiate specific Black Tern nesting study to determine effects (if any) of heavy metal and other contaminants on egg viability, chick health, and adult reproductive fitness.

Action: Provide cooperative wildlife survey assistance to tribal wildlife programs.

Objective: Maintain 50 breeding pairs of Tricolored Blackbird on suitable nesting marshes in Carson Valley through 2022.

"50 breeding pairs" – based on the population estimate of 100 in the Nevada Comprehensive Bird Conservation Plan (2010) rather than on the 10-year average of 20 pairs identified in the same Plan.

Action: Continue to seek cooperative conservation strategies with landowners of the current known Tricolored Blackbird colony sites in Carson Valley.

Action: Provide alternate marsh habitat suitable for Tricolored Blackbird nesting on public or private managed conservation lands in Carson Valley (e.g., Forks Ranch managed by The Nature Conservancy).

Objective: Maintain Pahranagat Valley montane vole populations at detectable levels on known occupied sites in White River and Pahranagat Valleys through 2022.

"detectable levels" – as determined by live trap survey conducted at regular intervals not to exceed five years.

Action: Develop and maintain cooperative working relationships with landowners in Pahranagat Valley montane vole range to allow regular routine status surveys.

Action: Develop conservation strategies for marsh lands and meadows on private land conducive to montane vole population maintenance and link strategy to landowner incentives program projects to provide assistance and compensation for beneficial land management activities.

Objective: Maintain priority secretive marsh birds at detectable levels in known occupied sites statewide through 2022.

"priority secretive marsh birds" – American Bittern, Least Bittern, Yuma Clapper Rail

"detectable levels" – as determined by taped call survey conducted at regular intervals not to exceed five years.

Action: Maintain stands of summer-long flooded high-density emergent bulrush/cattail marsh as a regular element of annual marsh management on all managed marshes.

Action: Conduct taped call surveys using the USFWS Secretive Marsh Bird survey protocol (Conway and Nadeau 2006); contribute survey data to National Secretive Marsh Bird Survey database.

Action: Update Status Report and Management Plan for Yuma Clapper Rail as per USFWS requirements.

Objective: Maintain suitable habitat for 100,000 foraging migratory arctic breeding shorebirds on the combined Lahontan Valley-Humboldt Sink wetland complexes through 2022.

"suitable habitat" – waters deployed at shallow depths (less than six inches) with rich invertebrate densities during the periods between April 1 and May 15 and July 1 and October 1.

"100,000 … "-peak seasonal attendance during the 1985-95 drought/flood cycle, not attained since for undetermined reasons related to habitat quality and/or global population declines

"migratory arctic breeding shorebirds" – all Charadriid species, but focused on Long-billed Dowitchers, Western Sandpipers, and Red-necked Phalaropes.

Action: Continue developing technical knowledge base for water management, including delivery timing, water level manipulation, etc. to include specific outputs and objectives for all wetland wildlife – nesting, migrating, and wintering waterfowl; nesting and migrating shorebirds; nesting and migrating fish-eating birds; colonial-nesting birds; marsh-dwelling mammals; dry-season predators; endemic amphibians; and endemic fishes.

Action: Develop an Intermountain West wetland management network that cooperatively develops intermountain wetland population management objectives for the purpose of maintaining thriving, self-sustaining populations of wildlife at the regional and hemispheric scales.

Action: Maintain Western Hemispheric Shorebird Reserve status for Lahontan Valley Wetlands. Include Humboldt Sink as part of the designation area. Complete a shorebird conservation plan for the WHSRN site with Intermountain West Joint Venture assistance.

Objective: Maintain statewide wintering populations of 6,000 Northern Pintails, 5,000 Canvasbacks, and 4,500 Redheads over the ten-year average through 2022.

"wintering populations" – as monitored by the Midwinter Waterfowl Aerial Survey conducted annually.

Action: Maintain flooded units with maximum-growth submergent pondweed stands on managed wetlands from September 1 through March 15.

Objective: Maintain statewide breeding populations of 2,300 Canvasbacks, 300 Northern Pintails, and 200 Redheads over the ten-year average through 2022.

"breeding populations" – as monitored by the Waterfowl Breeding Pair Aerial Survey conducted annually.

Action: Maintain flooded units with a variety of emergent plant stands including hardstem bulrush, cattail, alkali bulrush, and pasture grasses from March 1 through August 1.

Action: Encourage and support native haymeadow management practices that allow for undisturbed waterfowl and shorebird nesting through the breeding season.

Objective: Maintain statewide wintering populations of priority raptors at stable or increasing trend within natural range of annual fluctuation through 2022.

"priority raptors" – Bald Eagle, Ferruginous Hawk, Prairie Falcon, Peregrine Falcon (mostly Clark County)

"stable or increasing trend…" – as determined by statewide winter raptor surveys conducted at regular intervals not to exceed five years

"natural range… annual fluctuation" – recognizing that wintering raptor visitation in Nevada is annually influenced by many factors that exist outside of state boundaries, including annual climate conditions and out-of-state breeding success, but for which natural annual variance and longer-term amplitude could be accounted for with scientifically-designed and judiciously executed surveys over an appropriate span of years.

Action: Continue statewide winter raptor surveys and add special surveys focused on key managed wetland sites with particular focus on years of high raptor concentration at these sites induced by favorable local foraging conditions.

Objective: Develop a population estimate and trend for Common Nighthawk in Nevada by 2022.

"population estimate and trend" – through species-focused survey supplementary to USGS Breeding Bird Survey conducted at regular intervals until statewide coverage is satisfactory and a working knowledge of general numbers and status is achieved.

Action: Conduct surveys commensurate with Partners In Flight nightjar surveys as conducted throughout the western U.S.

(Management objectives for Short-eared Owl, Greater Sandhill Crane, Bobolink, breeding Wilson's Phalaropes, and breeding Peregrine Falcons and Prairie Falcons found in other key habitat chapters.)

Objective: Maintain priority amphibian and native fish species at detectable levels at all currently known occurrence locations through 2022.

"priority amphibian species" – Amargosa toad, Columbia spotted frog, northern leopard frog, western toad, Great Plains toad

"detectable levels" – as determined by appropriate survey methods conducted at regular intervals not to exceed five years

Action: Identify important permanent and ephemeral wetland sites on public lands for priority amphibian species, and cooperatively prioritize protection and restoration actions through BLM and USFS planning processes to insure maintenance and enhancement.

Action: Identify important mesic marsh sites supporting priority native fish species of concern and design/implement strategies for invasive species control and to secure water rights to maintain those habitats

Action: Implement a coordinated statewide distributional survey and inventory of Northern leopard frog and Western toad occurrence and populations to guide future status monitoring and habitat protection and restoration efforts.

Action: Identify appropriate survey methods and implement status monitoring for priority amphibian species not included in existing Conservation Agreement programs (Western toad, Great Plains toad, northern leopard frog) at regular intervals not to exceed five years.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Private	37.4
Open water	26.2
Bureau of Land Management	13.0
U.S. Bureau of Reclamation	10.2
Tribal	2.8
Other	1.6

Existing partnerships, plans, and programs

- Nevada Wetlands Plan
- Swan Lake Natural Area steering committee
- Carson Lake Transfer
- Humboldt River /Argenta Transfer

Federal Agencies & State Agencies

- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service/Conservation Districts
- Bureau of Land Management
- Bureau of Reclamation
- Nevada Department of Wildlife
- Nevada Division of State Parks
- Nevada Natural Heritage Program

Counties/Cities

- Truckee-Carson Irrigation District
- Walker River Irrigation District
- Churchill County Quality of Life Plan
- Incline Village General Improvement District Sewer Treatment Wetland

Sportsmen's Organizations

- Nevada Waterfowl Association
- Canvasback Gun Club
- Greenhead Hunting Club
- Ducks Unlimited

Conservation Organizations

- Nevada Wetlands Coalition
- The Nature Conservancy
- Lahontan Audubon Society/National Audubon Society
- Nevada Waterfowl Association
- Ducks Unlimited

Bird Conservation Initiatives

- U.S. Shorebird Conservation Plan
- Western Hemispheric Shorebird Reserve Network
- North American Waterfowl Management Plan
- North American Waterbird Conservation Plan
- Partners In Flight
- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight

Other Key Partners

- Intermountain West Joint Venture
- Great Basin Bird Observatory
- Mining Industry/Nevada Mining Association
- University of Nevada

Focal Areas

Amargosa Desert
Carson Range
Carson Sink
Carson Valley
Granite Range
Pahranagat Valley
Pyramid Lake Valley
Ruby Valley
Sheldon NWR
Spring Valley
Steptoe Valley
White River Valley

Lakes & Reservoirs

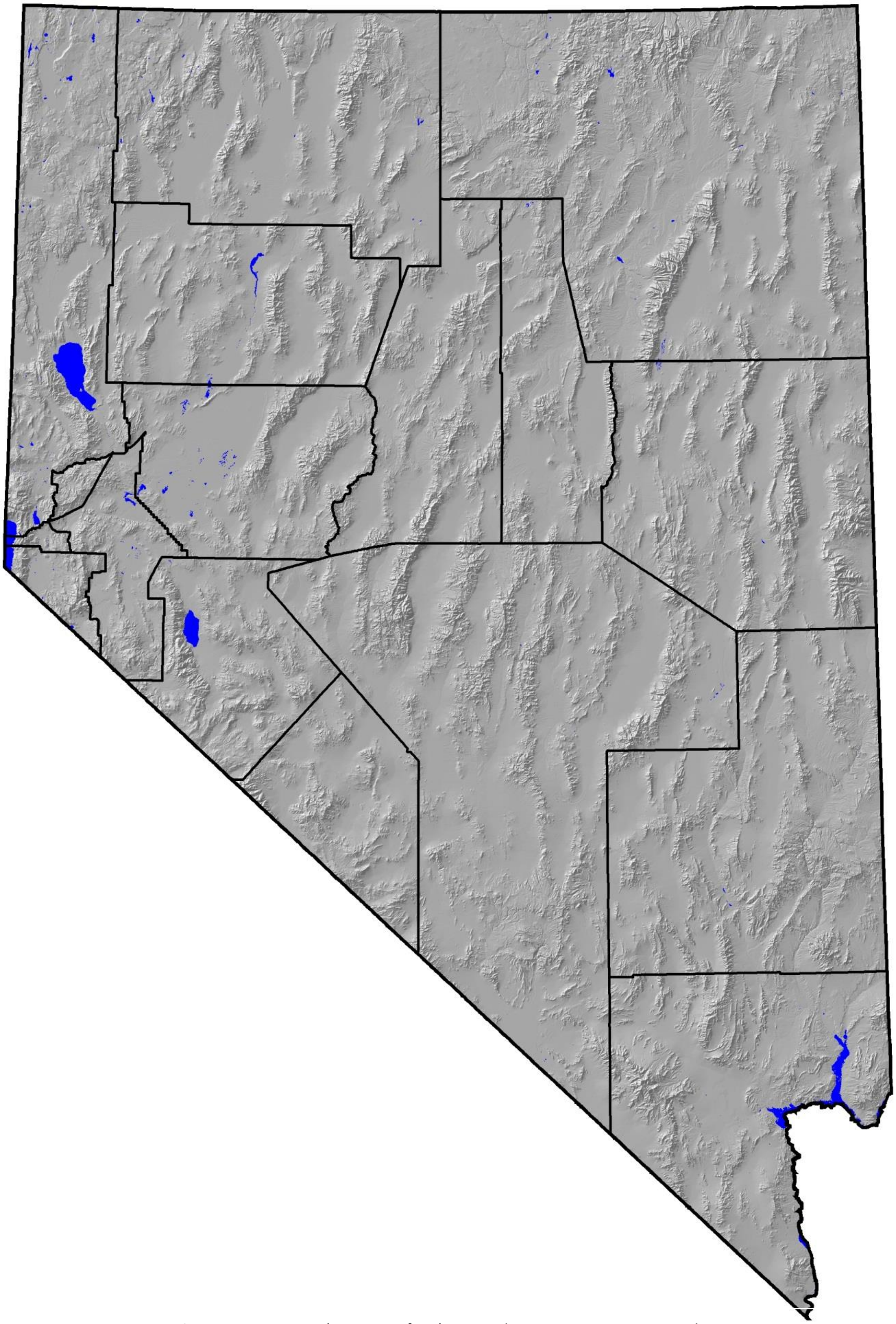


Figure 20: Distribution of Lakes and Reservoirs in Nevada.

KEY HABITAT: LAKES AND RESERVOIRS

Things to Know….

- Terminal lakes are a unique feature found in Nevada due to the basin and range topography creating closed hydrologic basins.
- The open water is important for migrating waterfowl and shorebirds, as well as some endemic fish species. Key priority species include American White Pelican, flannelmouth sucker, razorback sucker, and bonytail.
- Greatest threat to lakes and reservoirs is water demand creating a permanent or temporary loss or modification of open water habitat.
- Climate change effects are expected to maintain or improve storage capacity due to increased winter –period precipitation.

Ecoregions

Southwest ReGAP 2005

Great Basin	82,604 hectares	204,115 acres
Mojave	45,440 hectares	112,284 acres
Sierra Nevada	15,706 hectares	38,810 acres
Columbia Plateau	7,796 hectares	19,264 acres
Total	151,546 hectares	374,473 acres

Ecological Systems*

SWReGAP Ecological Systems

N11 Open Water
A017 Natural Lakes
A018 Reservoirs
A019 Montane pools

*no TNC Biophysical Settings developed

Key Habitat Description

The lakes and reservoirs key habitat includes areas of open water, generally with less than 25% cover of vegetation or soil, including natural lakes, impoundments, and montane pools. Playa lakes and ephemeral water bodies are addressed in a separate strategy. Few of Nevada's water bodies are large in size, other than Lake Tahoe (a part of which lies in Nevada), Pyramid Lake, Walker Lake, Lake Mead, and Lake Mohave. Numerous smaller water bodies, many of them created as reservoirs, dot the landscape. Whether constructed or natural in origin, open water bodies in the state often have some adjacent feature that, while not technically open water, acts synergistically to provide a combination of features that enhance the value of the site for wildlife. These adjacent features may include cliffs, emergent marshes, mud flats, beaches, or islands.

Natural lakes of all sizes will change in surface elevation and storage depending on seasonal precipitation and other factors, but except in periods of drought and significant climatic variation these changes are relatively minor and play an important role in maintaining shoreline and emergent habitats. Terminal lakes are unique to

Nevada and other arid landscapes characterized by basin and range topography creating closed hydrographic drainage basins, and have unique attributes and characteristics, particularly for water quality dependent on inflow from their associated isolated hydrographic basins. These conditions may result in unique vegetation and species assemblages and makes them particularly vulnerable to changes in inflow from water development or drought conditions. In contrast, constructed impoundments and reservoirs may vary widely, either seasonally or annually, in size, storage and surface elevation, with these fluctuations driven by storage requirements, irrigation demand, power generation, drought, and other factors. These periodic elevation changes, which can reach as much as 50 feet annually on large reservoirs such as Lake Mead, can have significant effects on the availability and maintenance of near-shore aquatic and shoreline transition habitats for both aquatic and terrestrial species.

Montane pools exist occasionally throughout mid- to high-elevation montane habitats in Nevada, frequently in association with wet meadow and other mesic montane habitat types. These shallow aquatic habitats may be permanent or seasonally ephemeral depending on soils, seasonal precipitation levels, and short- or long-term climatic conditions, but provide an important lentic attribute to the landscape in areas generally dominated by terrestrial mesic and lotic flowing water habitat types.

Value to Wildlife

As with riparian systems and any landscape in Nevada characterized by the presence of water, open water systems play a critical role in the maintenance of wildlife populations in the state. Numerous species of waterfowl require open water for resting, including during their epic annual migrations, and as the only type of habitat in which they can feed. Many species of aquatic wildlife can live nowhere else, including a variety of fishes. Because of the importance of water for insects, a variety of birds and bats focus their foraging efforts over open water. Natural lakes, including terminal lakes, have also played an important role in the evolution and maintenance of native aquatic species and in supporting unique endemic vertebrate and invertebrate species assemblages. For some endemic fishes, including the species of conservation priority, the availability of persistent open water habitats has resulted in the evolution of lacustrine or lake-form variations with unique systematic characteristics differing physically from lotic or flowing-water types of the same species or sub-species. Open water habitats play an obvious critical role in maintaining these unique adaptations.

Constructed reservoirs have been incontrovertible features on the landscape of the American West for almost a century now. Although the creation of these reservoirs has necessitated a series of habitat value tradeoffs by inundating riparian habitats, affecting wetlands by altering water management downstream, and creating habitats which support non-native aquatic and invasive plant species, many of them are quite prolific fish producers, and as such have created significant summering, wintering, and migratory staging sites for fish-eating birds such as Common Loon and American White Pelican. Anaho Island in Pyramid Lake is the site of one of the largest American White Pelican nesting colonies in the western U.S., attended by as many as 12,000 breeding adults in peak years. Before the collapse of its fish resource, Walker Lake was the site of the largest inland concentration of migrating Common Loons in North America, peaking at 1,500 birds in the mid-1990s. Some endemic fishes, have adapted to constructed lentic habitats and these landscape features support large adult populations of those species, particularly where they are connected to flowing water systems that support critical life stages. Probably the most significant reservoir in the state relative to bird use is Lake Mead, behind Hoover Dam on the Colorado River. Lake Mead may provide staging and wintering habitat for a large percentage of the Western and Clark's Grebes in the western U.S. Other constructed reservoirs supporting significant bird resources include Lahontan Reservoir on the Carson River, Rye Patch and South Fork Reservoirs on the Humboldt River, and Wildhorse Reservoir on the Owyhee River. Lakes Mead and Mohave are critically important in their role for the conservation of endangered Colorado River basin endangered fishes. Lake Mead has one of the few remaining wild razorback sucker populations which has demonstrated natural recruitment, while Lake Mohave supports the largest extant wild adult population of razorback sucker which is a critical genetic resource for species conservation and recovery.

Montane pools, as a unique landscape feature generally associated with mid- and high-elevation mesic habitat types, also play an important role for wildlife by providing permanent or seasonal open water and shoreline emergent habitat types in areas otherwise devoid of aquatic habitats or dominated by flowing water systems. Although often fishless because of ephemeral, seasonal occurrence or discontinuity with lotic systems, these pool features are critically important in supporting all life stages of amphibian species and unique species assemblages of invertebrates.

Key Elements of Lakes and Reservoirs Habitat Important to Wildlife

OPEN WATER – foraging, resting, protection from predators

- Common Loon
- Black Tern
- Red-necked Phalarope
- Bald Eagle
- Canvasback
- Northern Pintail
- Redhead
- little brown myotis

NATURAL/TERMINAL LAKES

- Cui-ui
- Lahontan cutthroat trout – Western DPS
- Railroad Valley tui chub
- Columbia spotted frog – Northeast Nevada sub-population
- Columbia spotted frog – Toiyabe sub-population
- Mountain yellow-legged frog
- Northern leopard frog
- California floater

RESERVOIRS/IMPOUNDMENTS

- Bonytail
- Razorback sucker
- Independence Valley speckled dace
- Independence Valley tui chub
- Wall Canyon sucker
- Pahrump poolfish
- Dixie Valley tui chub
- Diamond Valley speckled dace
- Lahontan cutthroat trout – Western DPS
- Lahontan cutthroat trout – Quinn/Black Rock and Humboldt DPSs
- Oasis Valley speckled dace
- Railroad Valley tui chub

White River speckled dace
White River desert sucker
Amargosa toad
Columbia spotted frog – Northeastern Nevada sub-population.
Columbia spotted frog – Toiyabe sub-population
Northern leopard frog
California floater

MONTANE POOLS
Columbia spotted frog – Northeast Nevada sub-population
Columbia spotted frog – Toiyabe sub-population
Northern leopard frog
Mountain yellow-legged frog

ISLANDS-nesting, protection from predators, foraging
American White Pelican

CLIFFS AND SANDY BLUFFS-nesting substrate, roosting
Peregrine Falcon
Bank Swallow

BULRUSH/CATTAIL FRINGE-foraging, nesting, protection from predators
White-faced Ibis

SHORELINE/BEACH – foraging, nesting
Western Snowy Plover
Long-billed Dowitcher
American Avocet
Western sandpiper
Wilson's Phalarope

Existing Environment

Land/Water Uses

- Hydroelectric power production
- Irrigation diversion
- Storage and water level regulation (reservoirs and impoundments)
- Non-native and invasive aquatic species
- Invasive plants/noxious weeds
- Flood control
- Groundwater development
- Motorized recreation
- Non-motorized recreation
- Recreation development
- Urban/suburban development
- Waste and hazardous materials disposal
- Municipal wastewater/treated effluent and urban stormwater runoff

- Industrial discharge and groundwater contaminants
- Species harvest

Habitat Conditions

Nevada's permanent lakes are primarily either terminal basins or artificial impoundments. Because of the natural occurrence of minerals and salts in their watersheds, these lakes and reservoirs are natural sumps for the transport and collection of a variety of salts, heavy metals, and other dissolved solids. As such, even without inflows of pollutants, water quality in many lakes would not meet most people's expectations of pristine waters. Nonetheless, in the absence of anthropogenic pollutants or alterations in flow, all open water bodies in Nevada would meet the needs of wildlife.

Some rivers in Nevada were heavily contaminated with mercury during the mining heyday of the late 1800s, and these contaminants have affected associated lake and reservoir habitats. On the other extreme, Lake Tahoe is undoubtedly the most intensively managed and healthiest lake in the state, though water quality issues remain to be addressed there as well. In contrast, Walker Lake is the most threatened water body in the state, with significant water quality issues due not only to mercury, but also to upstream water diversions. Water quality in Pyramid Lake has also suffered due to water diversion from the Truckee River, although significant efforts are underway to assure more reliable water delivery to the lake. The presently dry Winnemucca Lake, located in the valley just east of Pyramid Lake, was once a National Wildlife Refuge comprised of an actual lake and an important fishery. The same water diversion that threatens the condition of Pyramid Lake destroyed Winnemucca Lake and now the site is a barren playa that briefly holds water after rare heavy rains.

Water quality and quantity in Lakes Mead and Mojave are relatively good. To some degree water quantity is regulated by the dams impounding these water bodies, though recent extended drought conditions in the upper Colorado River Basin and resultant low flows in the Colorado River have resulted in a decline in lake levels and shoreline retreat to an extent not seen since initial reaservoir filling in the 1930s. Although Lake Mead water storage is currently increasing, future conditions will be largely dependent on snowpack and runoff conditions in upper Colorado River Basin states. Water quality can be compromised by tributary inputs, principally agricultural in nature, and by treated wastewater and storm water runoff from Las Vegas Valley and various upstream urban areas. Industrial contaminants have entered the system, the most notable of which is probably perchlorate, the effects of which on wildlife are largely unknown, but current monitoring efforts indicate that the occurrence of contaminants and other discharge components is generally well within standards and guidelines for water quality and effects to wildlife, and effective remediation programs to reduce inputs of contaminants such as perchlorate are in place. In contrast to Lake Mead, which serves as the initial storage reservoir for Colorado River discharge from the river's upper basin and also must provide long-term storage of agricultural and municipal water supplies and capacity for major flood runoff, resulting in frequently changing interannual storage levels, Lake Mohave acts as a regulator for discharge from Hoover Dam to release constant flows for Colorado River downstream water users. Because of this Lake Mohave surface elevations change frequently but to a much smaller degree of magnitude. Lake Mohave near-shore habitats thus tend to show a much greater degree of stability over time. Lake Mohave also lacks perennial tributary and large-scale municipal input sources and hence has less direct exposure to industrial pollutants and flood flows.

Problems Facing the Species and Habitats

The growing demand for water in urbanizing regions of the state is threatening a permanent or temporary loss or modification of open water habitat. Similarly, diversions could continue to modify hydrologic regimes, interrupting natural flow dynamics that result in modified channel and floodplain processes. Reductions in inflows from water diversion or recurrent and cyclical natural drought conditions particularly affect terminal lake systems because of constrained inflow with impacts to water quality and water chemistry from the concentration of naturally occurring and introduced compounds and toxins. Similarly, reservoir habitats are impacted from drought, or reduced inflows, by reducing storage which alters near-shore and shoreline habitats and affects water quality and storage/exchange time including retention of sediments and contaminants.

Loss of habitat quality indirectly leads to disturbance to wildlife movements, behavior, reproductive success, or actual displacement. Disturbance can also be generated directly through over-utilization by recreationists. As with almost all systems in Nevada, non-native and invasive plants and animals are a potential threat to open water systems, primarily threatening aquatic wildlife (e.g., fish, amphibians, mollusks). Large permanent impoundments, while providing new habitat for aquatic (primarily non-native) species, can significantly disrupt life cycle processes for endemic fishes and freshwater mussels, including species of conservation need, by permanently altering habitat characteristics and encouraging predation and competition by non-native, introduced aquatic species. In the case of the Arizona (southwestern) toad, loss of genetic integrity has been associated with increased impoundments that favor the Woodhouse's toad. The range of the Woodhouse toad has expanded into former Arizona toad habitat due to impoundments, resulting in interbreeding and genetic swamping, and diminishing the geographic range of genetically pure Arizona toads. Finally, runoff threatens some systems where inflows cause erosion, carry high sediment loads, or create excessive nutrient and toxin loading.

Montane pool habitats are subject to the same stressors and threats affecting associated riparian and meadow/mesic habitats, including inappropriate land use practices, recreation and road development, and water development and diversion that would affect groundwater maintenance and recharge. Threats to these aquatic habitats are of particular concern because of their relative scarcity on the landscape, and the unique challenges associate with effective protection and restoration at high elevations and in mesic soils.

Predicted Climate Change Effects

Because the extent of lake and reservoir open water habitats in Nevada is largely dependent on input from associated stream and river systems, and in most cases those input flowing water systems are dependent on snow-pack based runoff from local or regional watersheds for the majority of their cumulative annual discharge, the maintenance of these habitats over the next 50 years will be to a great extent influenced by predicted changes in winter-period precipitation. Most available climate models suggest minor to substantial increases in winter-period precipitation across much of Nevada and areas of adjacent states influencing important Nevada watersheds, including the Great Basin, eastern Sierra Front, the northern Colorado Plateau and central and northern areas of the upper Colorado River Basin. The potential net effect of these changes, with some cautions, could be the maintenance or increase of storage levels in the majority of larger lakes and impoundments in Nevada through 2022 with an associated increase in areas of shallow aquatic and near-shore moist soil habitats lost during recent long-term drought cycles. Several conditions could mitigate this result, however. Local precipitation conditions and the uncertainty of large scale regional precipitation models make it extremely difficult to predict future conditions for smaller and isolated lakes and impoundments, which on an individual basis are not as likely to show positive effects to larger impoundments influenced by broader watershed conditions. Generally increasing year-round air temperatures will affect total snowpack accumulation, particularly in southern areas of the state, and the potential for earlier spring onset and an increase in rain-on-snow events could increase the flashiness of runoff inputs and encourage shorter-duration, higher intensity runoff periods in many systems. Earlier onset of storage coupled with higher summer and fall air temperatures and decreased late spring (southern Nevada) and summer (central and northern Nevada) precipitation could influence effective evaporation rates mitigating to some extent any benefits from increased total annual runoff, particularly in smaller shallow and isolated open water bodies. A predicted earlier onset and increased frequency of summer monsoonal rain events in southern and south-central Nevada is expected to primarily influence other key habitat types (playas and warm desert rivers and streams) and little effect is expected on permanent open water habitats.

Possible Wildlife Responses to Climate Change

Independent of anthropogenic influences on surface water inputs to open water lake and reservoir habitats, projected climate change effects on wildlife in those habitats through 2022 are expected to be neutral to moderately positive. Stable or increased storage levels will maintain the availability of these systems for resident endemic fishes and waterfowl, and near-shore moist soil conditions for shorebird species will continue to available and could increase in total extent. A significant exception to this however, is terminal lake systems such as Walker and Pyramid lakes, where increased spring runoff-based inputs, if not intercepted for agriculture or other anthropogenic uses, could have a substantial beneficial effect over time in mitigating existing, declining water quality conditions and benefitting resident fishes and avian species. Effects on species utilizing smaller or isolated impoundments and montane pools are less clear-cut. To the extent that increased spring runoff based precipitation is actually available, total storage may increase for these smaller systems increasing total available near-shore terrestrial and aquatic habitat for priority native fish species and amphibians, but longer post-runoff storage duration, increased spring through fall air temperatures and changes in late-spring and summer precipitation patterns could negatively impact species dependent on shoreline interface habitats, particularly resident amphibians, during late summer and fall periods when an earlier onset of shoreline retraction and storage level declines could occur.

Taking Prescriptive Action

No specific prescriptive management was identified for open water lake and reservoir habitats. Both the potential benefits occurring to these habitat types from likely climate change effects, and negative effects to certain waters that might occur on a local scale as a result of localized climate and precipitation variability, will be largely driven by factors outside of influence from this plan. Changes in inputs to these receiving systems beyond those direct climate influences are driven by anthropogenic effects from water development and diversion, and existing water rights and water law authorizing use of current and future available system storage for purposes other than conservation of these habitats and resident priority wildlife species.

Priority Research Needs

- Hydrological investigations of sub-basin aquifer and groundwater connections to surface waters and in-stream flows
- Habitat restoration needs and approaches for species of conservation priority
- Effective methods for control and eradication of invasive aquatic species
- Analysis of reproduction and adult recruitment of razorback sucker in presence of an active managed non-native sport fishery
- Identification of Walker Lake Common Loon population wintering grounds

Conservation Strategy

Goal: Healthy aquatic ecosystems within the natural range of water quality, supporting thriving wildlife communities, and comprising uninterrupted food chains, from microscopic algae to top predators.

Objective: Improve water quality in the open waters of Nevada to provide high quality aquatic wildlife habitat.

Action: Implement riparian system strategies outlined elsewhere in this document to assure established, functioning upstream wetlands and marshes that will act as natural water filtration systems.

Action: Support and encourage the application of and requirement for Best Management Practices (BMPs) for all construction and maintenance activities in and associated with aquatic and riparian systems, through NDEP and ACoE permit requirements and other regulatory mechanisms.

Action: Encourage application of land management practices to exceed minimal proper functioning condition standards on all managed forest and rangelands to maximize aquatic system health.

Action: Support the application of appropriate standards for point- and non-point discharge and efforts to reduce and control input of toxins and contaminants to groundwater and aquatic systems by the EPA, NDEP, and other agencies, and enforcement of existing discharge permit standards and guidelines.

Objective: Eliminate or suppress exotic and invasive species that compete with native fauna or managed sport fisheries.

Action: Develop and disseminate public outreach materials regarding the consequences of releasing exotic species and means of avoiding the spread of invasive species.

Action: Temporarily drain small impoundments, as appropriate, to reduce or eliminate invasive species.

Action: Implement actions to remove undesired or nuisance nonnative species by physical or chemical control as identified in species management plans, species recovery plans and recovery implementation plans.

Action: Support research into effective methodologies for control of invasive aquatic species, particularly nonnative crayfish and amphibians.

Action: Finalize and implement the "Statewide Aquatic Invasive Species Management Plan".

Action: Continue implementation of the NDOW Aquatic Invasive Species program including provisions of AB167 (Aquatic Invasive Species legislation).

Action: Participate in the Lake Mead Interagency Quagga Team, Northern Nevada Quagga Task Force, the Lake Tahoe AIS Coordination Committee, and other regional coordination partnerships for invasive species control and containment.

Objective: Maintain or increase current water levels in lakes and reservoirs.

Action: Use the full array of conservation tools to achieve effective conservation status for Nevada's lakes and reservoirs, including the encouragement of active water conservation in municipal and agricultural uses, interagency agreements and purchase of water rights from willing sellers.

Action: Develop and disseminate public outreach materials regarding the critical importance of water conservation in Nevada for proper hydrologic function of Nevada ecosystems and the associated wildlife conservation benefits.

Action: Work to restore wetlands protection through regulation at the Federal level; supplement existing wetland preservation regulations through legislation and application at the State level.

Objective: Restore Walker Lake to a healthy, functioning terminal freshwater lake.

Action: Encourage the purchase and/or lease of water rights from willing sellers in the Walker Lake watershed for transfer to Walker Lake.

Action: Maintain refugia for Walker Lake strain fishes, including tui chub and the threatened Lahontan cutthroat trout in anticipation of returning Walker Lake to viable habitat.

Action: Continue to heighten public awareness of the conservation status of Walker Lake through press releases and annual seminars.

Action: Develop partnerships with farming interests in the Walker River watershed to create a water efficient cropping strategy based on low-water need crops and efficient water deliver systems.

Action: Work with the WRID and producers in the Walker River watershed to improve efficiency in water delivery systems.

Action: Work with county planners to integrate water-efficient design requirements into residential development permits within the Walker River watershed.

Action: Identify the capacity of the Walker River watershed, and groundwater resources contained therein, to sustain additional commercial and residential development; work with county planners to integrate these limits in relevant master plans.

Action: Work with conservation partners and others (e.g. National Fish and Wildlife Foundation, U.S. Fish and Wildlife Service, Natural Resources Conservation Service, Walker River Paiute Tribe) to explore opportunities to implement restoration strategies that would improve the condition of the Walker River channel and attendant riparian corridor.

Objective: Maintain suitable habitat for at least 200 wintering Bald Eagles annually through 2022.

"suitable habitat" – wintering raptor numbers are not solely dependent on habitat conditions within the state; sometimes factors influencing winter raptor visitation in Nevada are occurring outside state boundaries completely beyond Nevadans' control or influence.

"200 wintering Bald Eagles" – 2010 statewide count (NDOW 2011) with over 160 occurring in southern Nevada, mostly associated with Lakes Mead and Mojave.

Action: Preserve the permanent fisheries in Lakes Mead and Mojave, Pyramid Lake, Lahontan Reservoir, and others of importance to wintering Bald Eagles.

Objective: Maintain current Bald Eagle nesting sites in Nevada and provide due management and protection to any new nesting sites that may occur through 2022.

"current… nesting sites" - currently three in Nevada.

Action: Manage Bald Eagle nest sites according to USFWS guidelines (2009).

Objective: Maintain birds of conservation priority at stable or increasing trend through 2022.

"birds of conservation priority" – Common Loon; Black Tern; Red-necked Phalarope; Canvasback; Northern Pintail; Redhead; Western Snowy Plover; Long-billed Dowitcher; American Avocet; Western Sandpiper; Wilson's Phalarope; Peregrine Falcon; Bank Swallow

"stable or increasing trend" – as determined by USGS Breeding Bird Survey, Nevada Bird Count, NDOW Breeding Raptor Surveys, or other surveys as appropriate to be conducted at intervals not to exceed five years.

Action: Develop or enhance existing technical knowledge base for water management, including delivery timing and water level manipulation, to include specific outputs and objectives for all wetland wildlife – nesting, migrating, and wintering waterfowl; nesting and migrating shorebirds; nesting and migrating fish-eating birds; colonial-nesting birds; marsh-dwelling mammals and dry-season predators.

Action: Adopt priority species population objectives from continental and regional bird conservation initiatives, step continental and regional objectives down to reflect Nevada's capability, and set conservation action toward achievement of those objectives.

Objective: Maintain or increase the quality and availability of lake, reservoir and small impoundment open water habitat for priority fish and amphibian species through 2022.

Action: Continue the recovery and conservation efforts for razorback sucker and bonytail in Lake Mead and Lake Mohave through support of the Lake Mead Razorback Sucker Work Group, Lake Mohave Native Fish Work Group activities and implementation of the Lower Colorado River Multi-Species Conservation Program.

Action: Continue active implementation of open-water associated objective and actions in species management plans for tui chub species, Wall Canyon sucker, and other priority native fish species of concern.

Action: Continue active implementation of open-water associated objective and actions in Conservation Strategies for Amargosa toad and Columbia spotted frog and for other priority amphibian species.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
State of Nevada (open water)	83.4
Tribal	6.2
Private	4.5
Bureau of Reclamation	2.3
Bureau of Land Management	1.8
U.S. Fish & Wildlife Service	0.7

Existing partnerships, plans, and programs

Major Programs & Partnerships

- Lower Colorado River Multi-Species Conservation Program (MSCP)
- Terminal Desert Lake Program
- Truckee River Operating Agreement

Recovery Implementation Teams

- Colorado River Fishes
- Walker River
- Truckee River

Conservation Agreements

- Northeastern Nevada Columbia Spotted Frog
- Toiyabe Columbia Spotted Frog

Federal & State Agencies

- Nevada Department of Wildlife
- Nevada Natural Heritage Program
- Nevada Division of State Parks
    - Washoe Lake
    - Lahontan Reservoir
    - Cave Lake
    - Wild Horse Reservoir

  - Eagle Valley Reservoir
  - Echo Canyon Reservoir
- Bureau of Land Management
- Bureau of Reclamation (Colorado River & Lahontan Area)
- U.S. Forest Service
- U.S. Fish & Wildlife Service
  - Anaho Island NWR
  - Stillwater NWR Comprehensive Conservation Plan (CCP)
  - Pahranagat NWR CCP
  - Ruby Lakes NWR

Tribes
- Pyramid Lake Paiute Tribe & Fisheries
- Walker Lake Paiute Tribe
- Summit Lake Paiute Tribe

Counties
- County resource, open space, and recreation plans
- Truckee-Carson Irrigation District
- Walker River Irrigation District
- Pershing County Irrigation District

Conservation Organizations
- National Audubon Society/Lahontan Audubon Society (Important Bird Areas Program)
- Walker Lake Working Group
- Desert Fishes Council
- Declining Amphibian Population Task Force
- Partners in Amphibian and Reptile Conservation
- Sierra Club
- Walker River Conservation District
- Great Basin Bird Observatory
- Nevada Waterfowl Association
- Ducks Unlimited

Bird Conservation Initiatives
- U.S. Shorebird Conservation Plan
- Intermountain West Regional Report
- North American Waterbird Conservation Plan
- Intermountain West Waterbird Conservation Plan
- Partners In Flight, Nevada Partners In Flight & Nevada Bird Conservation Plan
- Colonial waterbird surveys and Nevada Bird Count

Focal Areas

Carson Range	Lake Mead	Pyramid Lake Valley	Walker Lake
Carson Sink	Owyhee River Area	Ruby Valley	
Crooks Lake and plateau	Piute Valley	Sheldon NWR	

Desert Playas & Ephemeral Pools

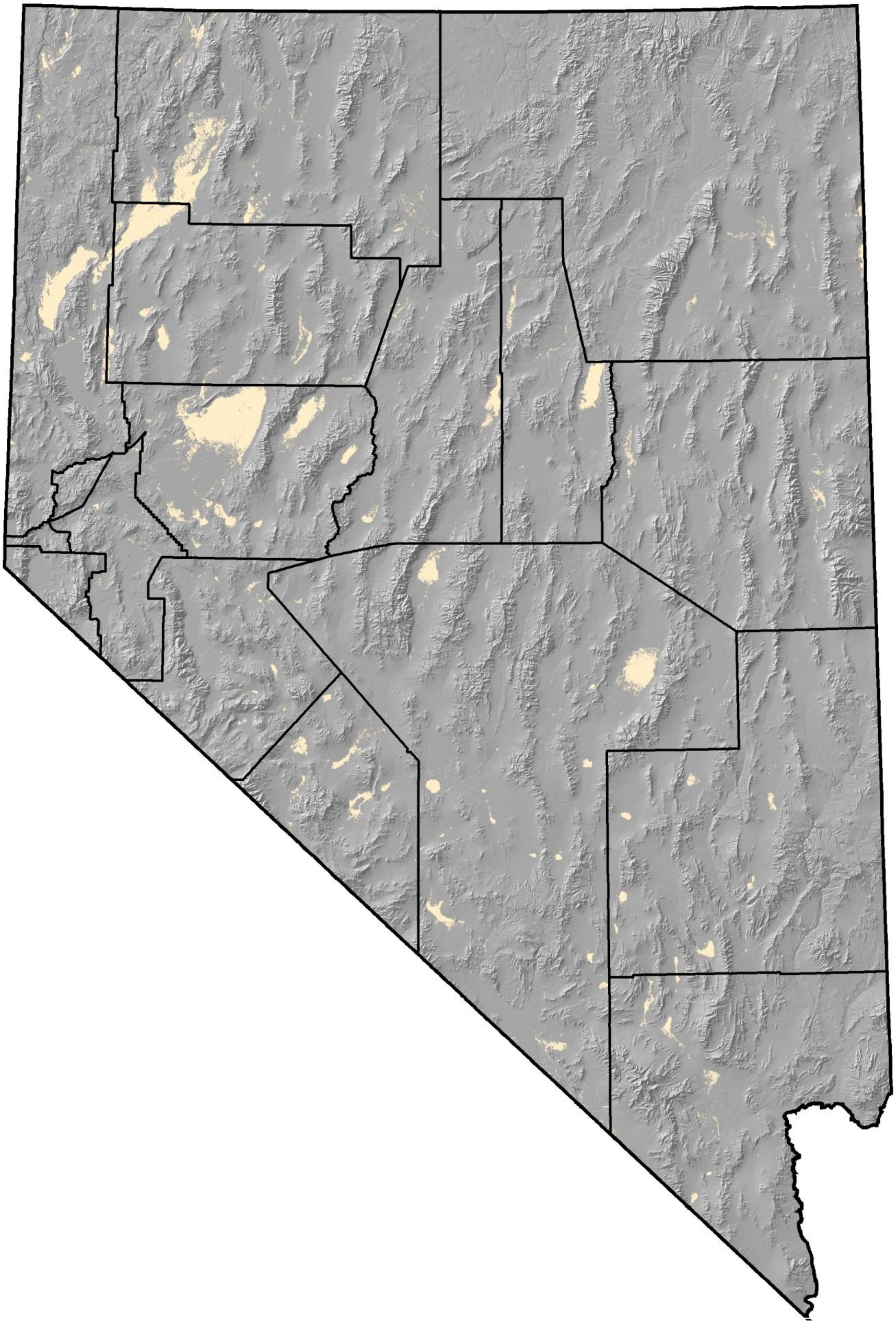


Figure 21: Distribution of Desert Playas and Ephemeral Pools in Nevada.

KEY HABITAT: DESERT PLAYAS AND EPHEMERAL POOLS

Things to Know….

- Desert playas and ephemeral pools are composed mostly of barren or sparsely vegetated playas found on valley bottoms and formed by intermittent flooding and evaporation.
- The value of this habitat is relative to the amount and duration of available water. The key priority species is Western Snowy Plover.
- Loss or alteration of hydrologic function is the greatest threat to this habitat type.
- Climate change is expected to affect playa fill rate and timing, evaporation rate, and amount of precipitation reaching the playa.

Ecoregions

Southwest ReGAP 2005

Great Basin	617,569 hectares	1,526,012 acres
Mojave	48,046 hectares	118,721 acres
Columbia Plateau	10,205 hectares	25,216 acres
Total	675,820 hectares	1,669,949 acres

Ecological Systems*

SWReGAP Ecological Systems

SO15 Intermountain Basins Playa
SO22 North American Warm Desert Playa
A020 Ephemeral Pools

*No TNC Biophysical Settings were developed

Key Habitat Description

This key habitat is composed of mostly barren or sparsely vegetated playas typically found on the valley bottoms in the intermountain and warm desert regions. Because of the flatness of much of the Columbia Plateau, playas can also form on the tops of its buttes and plateaus, such as can be seen on the Sheldon National Wildlife Refuge. Playas are formed by intermittent flooding and evaporation that precipitates fine soils and mineral salts onto the lowest flat depressions until an impermeable layer of sodic clay is lain down. Soil salinity varies greatly with soil moisture and greatly influences the plant species present at any particular time. Dry playas are often barren of vegetation from their center out to their outer margins, where saltgrass, pickleweed, or stunted greasewood maintains a foothold on the fresher soils. When soils are kept moist but short of saturation over several weeks or months, Baltic rush, smartweed, sedges, and spikerushes emerge, in progressive order of wetness. This plant community is usually less than 60 cm tall, and can become quite dense in the absence of disturbance. With prolonged saturation more substantial emergent vegetation is established, including cattails, hardstem bulrushes, and alkali bulrushes (known locally as “nutgrasses”). These plants range from one to three meters tall and can grow sufficiently thick as to render a site impenetrable. Long-term inundation will facilitate establishment of a submergent plant community, typically characterized by pondweed; in more saline conditions, wigeon grass; and in fresher conditions arrowhead.

Ephemeral pools are broadly distributed across the state and range in size from small rock basins holding no more than one to two liters to large vernal lakes covering hundreds of hectares. By definition ephemeral pools dry up periodically, and typically hold water for only a few days to months. Most pools are heterotrophic, meaning that much of the energy passing through them comes from detritus, not direct photosynthetic production. Pools supporting a wetland/terrestrial plant community may be considered autochthonous in that vascular plant production during the dry phase provides detritus that supports the aquatic system during the next wet phase. Some systems (e.g., rock pools and playas) lack significant vascular plant production, most of their energy coming from allochthonous detritus blown in or carried into the basin from the surrounding watershed, and with primary production by algae in the basin varying in significance.

Value to Wildlife

Most playas in Nevada do not have permanent sources of water; therefore the value of playas to wildlife is largely ephemeral in nature. When playas are watered for the proper period of time, they can produce not only lush growth of emergent and submergent vegetation, but also prodigious volumes of aquatic invertebrates attracting a myriad of waterfowl, shorebirds, and small water birds. Submergent plants in these systems can build to such thick mats that they finally break the water's surface and present a structure sufficient to support the nests of Black Terns and American Avocets. When watered and loaded with invertebrates during spring or late summer, Nevada's ephemeral playas may contribute significantly to supporting waterfowl and shorebird migration. However, these areas are not always consistently occupied by wildlife, and the reasons why one filled playa is being heavily utilized by birds while another is practically bereft is unclear.

The iconic terrestrial species of Nevada's playas is the Snowy Plover, adapted to utilize some of Nevada's harshest landscapes with very few amenities. While wet playas are preferred to dry, the amount of water available does not have to be much and often Snowy Plovers use playas with only a rivulet coursing through them, or with a small wet corner, so long as they are dependably wet throughout the breeding season. Snowy Plovers thrive on brine flies and their larvae when occupying these habitats.

Occasionally a playa's "fill zone" will inundate a permanent spring that supports a small population of fish such as tui chub. At these rare times, the fish population can burgeon into the greater filled playa and becomes a windfall to foraging herons and grebes, although by-and-large, the energy cycle most often associated with ephemeral playas is a simple invertebrate-shorebird system. In other circumstances, former terminal lakes (e.g., Humboldt Sink and Carson Sink) are now functioning as playas because of agricultural water management, but in those years when the sinks fill with water, they also fill with magnificent densities of fish – mostly carp and tui chub – and become critically important food sources for the breeding American White Pelicans from Anaho Island in Pyramid Lake.

Although ephemeral pools have an intermittent role in support of purely aquatic vertebrate species under certain conditions, they can play a critical role in desert systems for maintaining populations of aquatic invertebrates such as brine, fairy, clam, and tadpole shrimp. Life cycles of these organisms are keyed to the seasonal boom/bust cycle of periodic inundation of playa habitats, especially during periodic wet cycles when their habitats remain wetted with standing surface water for extended periods. These pool inhabitants are either aquatic opportunists, species that occupy both temporary and permanent waters, or specialists with precise adaptations for living in temporary aquatic environments. While ephemeral pool communities have a fairly simple structure, species composition of these communities varies significantly. Most pools may be populated with widespread species, but some species are endemic to particular geographic regions or pool conditions. Much of the diversity in Nevada's ephemeral pools is still undocumented.

Although the relationship is poorly understood, ephemeral pools may provide an important function to certain amphibian species during periods of seasonal precipitation and high soil moisture, when those pools fill and provide standing water. As temporary standing water features, they likely facilitate movement and migration of those species in arid land ecosystems between core habitat areas of more permanent water, and assist in periodic distribution of individual animals within larger metapopulation complexes. Ephemeral pools available as a result of spring and summer period precipitation events may also play an important role in providing breeding habitat for Great Plains and Arizona toads and other endemic amphibians in desert ecosystems.

Key Elements of Desert Playas and Ephemeral Pools Important to Wildlife

BREEDING/BROODING–emergent and submergent vegetation, foraging

Snowy Plover
American Avocet
Long-billed Curlew
Northern Pintail
Canvasback
Redhead

MIGRATION – foraging

Black Tern
Long-billed Dowitcher
Western Sandpiper
Wilson’s Phalarope
Red-necked Phalarope

EPHEMERAL POOL – breeding, facilitate movement of amphibian species between areas of more permanent water

Amargosa toad
Arizona toad
Great Plains toad

TEMPORARY FISH POPULATIONS-foraging

American White Pelican
Bald Eagle

Existing Environment

Land Uses

- Motorized recreation
- Non-motorized recreation
- Minerals/oil/gas extraction
- Military mission
- Road development (rare)
- Urban/suburban development

Habitat Conditions

Most playas in Nevada are currently intact, owing largely to their intractability, but occasionally proposals are made to mine them for trace minerals. Ephemeral pools also are largely intact as landscape features, but are more subject to potential alteration or disturbance because of their small size and lack of prominence within other habitat types subject to development, recreational uses, and other perturbations. Their characteristics as natural sinks for capture of runoff and surface water somewhat limits their potential for disturbance, particularly from development, because of drainage issues and higher soil moisture.

Problems Facing the Species and Habitats

Playas are really only in jeopardy when land uses threaten to alter their normal hydrologic function. Of the species that utilize playas, the Snowy Plover, Long-billed Curlew, Northern Pintail, and Canvasback have generated the most conservation concern in recent years. While playas can significantly supplement available food resources for migratory waterfowl and shorebirds under favorable conditions, long-term surveys for both have documented the dominating influence of more dependable permanent wetlands on bird migration patterns and site use.

Ephemeral pools have a higher potential for alteration because of their limited size and a poor understanding of their importance to maintenance of arid land ecosystem function. Amphibian "Species of Conservation Priority" (SOCP) including endemic toad species may be highly dependent on these features for seasonal movement of individual animals and for metapopulation maintenance, but that relationship is poorly understood. Some species such as Great Basin and Arizona toads are opportunistic breeders that will utilize available temporary water on the landscape in the late spring and summer periods, and ephemeral pools may be particularly important to support their reproductive strategies in southern Nevada. Ephemeral pool specialists (fairy shrimp, tadpole shrimp) are not on the SOCP list because so little is known about them in Nevada. This habitat type is critical to their survival, but little is known about which species occur in Nevada, much less their geographic range.

Predicted Effects of Climate Change

Three factors might influence the dynamics of playa fill. Although playas receive moisture every year and predominantly during the winter and spring, they do not always fill due primarily to the approximate seven year cycling of El Nino-La Nina years. The amount of precipitation varies with the position of a year in the cycle. Climate models for the Sierra Nevada and much of Nevada generally predict no average change in total precipitation but increased variability in the amount of precipitation (TNC report). In other words, playa filling will become less predictable for species that depend on predictable fill (e.g., migrating birds), but years of high precipitation might translate into large macroinvertebrate and primary productivity, and good conditions for wildlife species that can survive years of severe low precipitation.

The second factor is the rate of evaporation of playa fill. The effect of evaporation is the easiest to predict because average temperature is expected to steadily increase by about 3°C over the next 100 years; therefore, playas will dry up faster during summer months than they do today regardless of geology and regional differences in precipitation. Therefore, the spring wildlife feeding and breeding period could be shorter and the late summer habitat for early fall migrants might be dry.

The third factor is the amount of precipitation reaching playas. Playa fill can originate either from rainfall or snowmelt runoff that infiltrates the shallow aquifer discharges at the water table. The contribution of snowmelt and the shallow aquifer is predicted to be a more sizable than direct rainfall. As a result, a certain lag time of water discharge is expected because groundwater movement and discharge are slower processes than surface water flow. Precipitation patterns predicted after 2040 indicate regional increases in winter precipitation ranging from zero (western-northwestern) to 25% (northeastern), but a decrease in spring precipitation ranging from zero (extreme northeastern) to 25% (lower west-central, or south ends of Toiyabe and Tonopah regions). Accompanying these variations in precipitation is a state-wide increase in temperature causing earlier snowmelt runoff either in streams or in the soil column (i.e., to the aquifer). The runoff would therefore occur during a period of low plant evapotranspiration, thus, enhancing groundwater recharge. The projected impact on playa fill and maintenance in western Nevada (Black Rock Plateau and Lahontan Basin regions) could be interpreted to be more dependent on snowmelt runoff and less sustained by spring rainfall. In the Elko region, playa fill would be expected to increase in the Snake River drainage of the region's northeast corner, and a no net change or slight increase in total fill in the lower elevation southeastern corner, but with a definite shift from spring to winter precipitation, a pattern also predicted for much of the rest of the state north of the Mojave Desert. Overall, playas could be expected to recharge earlier and persist for shorter time periods with faster, extended drying through the summer months and minimal change in fall recharge. In extreme southern and south-western Nevada, projected increases in mid- to late-summer precipitation and a temporal shift to higher frequency of summer monsoonal rain events could both alter the seasonal periods of playa surface water presence and increase the presence and persistence of ephemeral pool features during the late-spring through early fall periods. However, the extent of the changes (e.g., length and seasonality of wet periods) is difficult to quantify.

Possible Wildlife Responses to Climate Change

Migratory shorebirds such as Western Sandpiper and Long-billed Dowitcher pass through Nevada beginning roughly mid-March, steadily increasing in numbers through the last week in April with peak attendance at Nevada wetlands occurring sometime during the last two weeks in April. Numbers dwindle quickly after the first of May and most Arctic breeders have vacated the state by May 15. Phalaropes (both Wilson's and Red-necked) are the latest migrants and their numbers often peak the second week of May. In order for a playa to have dietary value to migratory shorebirds, it must; 1) have been wet long enough for invertebrates to have hatched, developed, and increased into favorable population densities; and 2) present water depths conducive to the use of the different species based on their leg length (long-legged avocets using the deepest waters and short-legged sandpipers only able to use the shallowest waters). With playas filling earlier and drawing down more rapidly, it is plausible to anticipate a migration stop scenario enhanced by earlier invertebrate growth periods and, if hydrated conditions persist into late April, water levels receding to favorable foraging depths for one or more groups of shorebirds. If the recharge and drawdown of playas occurs so early as to present characteristically dry conditions by late April, then dietary value to shorebirds would diminish.

Although the specific timing and duration of ephemeral pool occurrence in southern Nevada is not well understood, the distribution of ephemeral pool habitats across that arid landscape is closely keyed to stochastic and monsoonal rain events. These types of sites likely have an important role in supporting reproductive strategies for opportunistically breeding amphibians such as Great Plains and Arizona toads in the late spring and early to mid-summer periods. Although seasonal precipitation models have a particularly high degree of uncertainty, there is general consensus that a temporal shift of monsoonal precipitation to earlier in the summer period, and a general increase in spring/summer precipitation and a decrease in early fall precipitation is likely over the next 50 years in extreme southern and south-western Nevada. This seasonal change, if in fact it occurs, could have a positive effect on the availability and duration of ephemeral pool habitats during critical reproductive periods for certain priority amphibian species.

Priority Research Needs

- Invertebrate species composition for most playas and ephemeral pools
- Timing of invertebrate population booms after flooding dry playas (for the purpose of creating shorebird migration habitat on managed playas)
- Life history of ephemeral pool species, including tolerance ranges for various environmental parameters, ecological interactions among species, and relationships between ephemeral pools and surrounding ecosystems
- Role of ephemeral pools in seasonal movements and reproductive strategies of amphibians

Conservation Strategy

Goal: Healthy, dynamic aquatic ecosystems within the natural fluctuating range of water quantity and chemistry progressing from dry to fresh to saline; prolific self-perpetuating aquatic invertebrate and migratory bird communities

Objective: No net loss in playa area or hydrologic function through 2022.

Action: Protect playas from injurious excavation exercises associated with mining or livestock watering.

Action: Develop and implement a public outreach program to explain the value and function of playas.

Action: Insure playa and ephemeral pool habitats are addressed in land use planning and project development evaluations to maximize maintenance of these habitats and minimize disturbance from alteration, road construction, and recreational activities.

Objective: Maintain Nevada's breeding Snowy Plover population between 400 and 1,000 birds through 2022.

"between 400 and 1,000 birds" – 400 birds is roughly equivalent to the 2007-08 Snowy Plover statewide census; 1,000 birds is roughly equivalent to the 1980 statewide census; survey totals fluctuate widely with hydrologic conditions so a range of numbers is appropriate; statewide census conducted at regular intervals not to exceed 10 years.

Action: Inventory the aquatic invertebrate communities of Nevada's playas; determine timing and productive potential of invertebrate population booms; determine and develop opportunities for enhancement of bird migration and breeding.

Objective: Maintain metapopulation dynamics of opportunistically breeding ephemeral-pool dependent priority amphibian species through 2022

Action: Implement a distributional survey and inventory of Great Plains and Arizona toad occurrence and populations to guide future status monitoring, habitat protection and restoration efforts.

Action: Identify appropriate survey methods and implement status monitoring for Arizona and Great Plains toad at regular intervals not to exceed five years.

Action: Evaluate the importance of ephemeral pool habitats for movement and population maintenance of key amphibian species and as directed by outcome, incorporate strategies to protect those habitats within conservation planning for those species.

Objective: Maintain diversity of ephemeral-pool dependent aquatic invertebrate communities through 2022

Action: Inventory aquatic invertebrate communities of Nevada's ephemeral ponds and as directed by outcome, develop conservation strategies for those species of conservation concern.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	77.9
Private	9.4
Department of Defense	3.7
U.S. Fish & Wildlife Service	2.7
Other	2.7
Bureau of Reclamation	1.8
Tribal	1.8

Existing partnerships, plans, and programs

Federal & State Agencies

- Bureau of Land Management
- Bureau of Reclamation
- Environmental Protection Agency
- U.S. Fish & Wildlife Service
    - Stillwater NWR CCP
    - Sheldon NWR CCP
    - Desert Complex NWR CCP
    - Ruby NWR CCP
    - Office of Migratory Bird Management
- Nevada Department of Wildlife
- Nevada Natural Heritage Program
- Nevada Department of Environmental Protection

Conservation Organizations

- The Nature Conservancy

- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society
- Sierra Club
- Great Basin Bird Observatory
- Resource Advisory Board participation
- Nevada Wetlands Coalition (included sportsmen's organizations, Sierra Club, Lahontan Audubon Society, state and federal organizations)

Bird Conservation Initiatives

- U.S. Shorebird Conservation Plan
- Intermountain West Regional Report
- Western Hemispheric Shorebird Reserve Network
- North American Waterfowl Management Plan
- North American Waterfowl Conservation Act – funding for wetland restoration
- North American Waterbird Conservation Plan
- Intermountain West Waterbird Conservation Plan
- Partners In Flight
- Nevada Partners In Flight and Nevada Bird Conservation Plan with priorities and actions
- Nevada Audubon Important Bird Areas Program and IBA Conservation Plans
- Comprehensive bird monitoring – Nevada Bird Count

Counties/Cities

- Truckee-Carson Irrigation District
- Walker River Irrigation District
- County resource, open space and recreation plans
- Swan Lake Natural Area

Sportsmen's Organizations

- Nevada Waterfowl Association
- Canvasback Gun Club
- Stillwater Farms wetlands
- Greenhead Hunting Club
- Ducks Unlimited

Other Key Partners

- Intermountain West Joint Venture/Nevada State Steering Committee
- University of Nevada (UNLV, UNR, DRI)

Focal Areas

Amargosa Desert
Big Smoky Valley
Black Rock Desert West
Bog Hot Valley
Carson Sink
Fish Lake Valley
Indian Springs Valley
Las Vegas Valley
Railroad Valley
Sheldon NWR
Spring Valley

Sand Dunes & Badlands

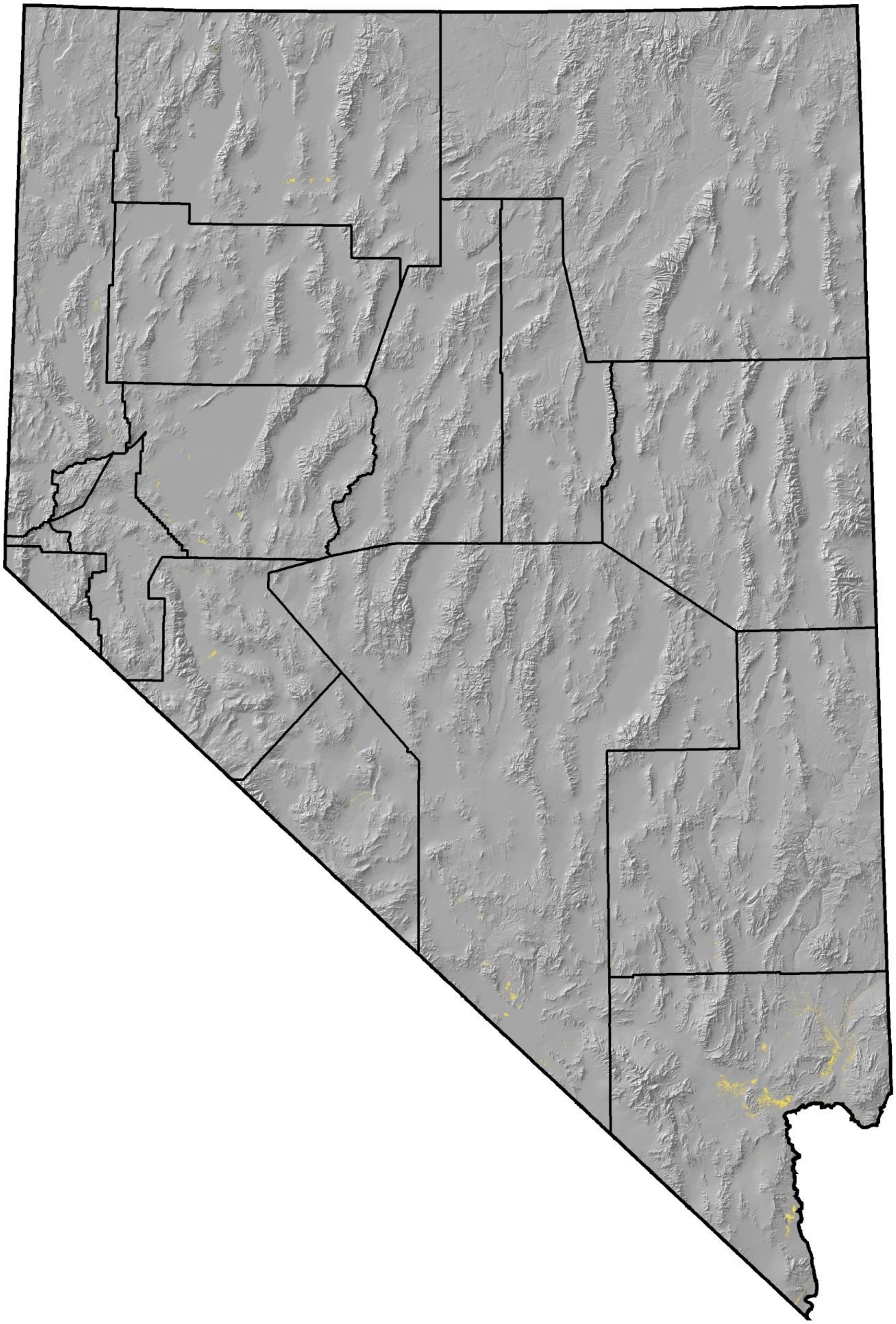


Figure 22: Distribution of Sand Dunes and Badlands in Nevada.

KEY HABITATS: SAND DUNES AND BADLANDS

Things to Know….

- Sand dunes and badlands are defined by substrate characteristics rather than vegetation and include rock outcrops, soil patches, and dunes.
- Numerous invertebrate species are endemic to this habitat type attracting various priority reptile species. Key priority species include desert kangaroo rat and sidewinder.
- OHV use is the greatest threat to this habitat type.
- Climate change effects analysis shows that “bare ground” will increase and vegetation around sand dunes will decrease and thereby increasing wind erosion, soil migration, and possibly decreasing wildlife habitat suitability.

Ecoregions

Southwest ReGAP 2005

Mojave	26,272 hectares	64,919 acres
Great Basin	7,875 hectares	19,461 acres
Columbia Plateau	53 hectares	131 acres
Total	34,200 hectares	84,511 acres

Ecological Systems*

SWReGAP Ecological Systems

S012 Intermountain Basins Active and Stabilized Dune
S017 North American Warm Desert Badland
S018 North American Warm Desert Active and Stabilized Dune
S021 North American Warm Desert Pavement

**TNC Biophysical Settings were not created for this key habitat*

Key Habitat Description

Sand dunes and badlands include ecological systems defined by substrate characteristics. They include relict bedrock outcrops, weathered soil patches, aeolian deposits (dunes), and other areas dominated by substrate rather than by vegetative cover. Sand dunes and badlands often define unique habitats and support endemic plants and animals, as well as provide habitat for generalist species (Nachlinger et al., 2001).

Nevada’s sand dunes were formed during the Holocene Epoch and are unique habitats because they are rare, small, of recent origin, and spatially dynamic (Brussard et al., 1998). Sand dune habitats consist of stabilized to partially stabilized sand dunes dominated by desert sand verbena, big greasewood, dale, ricegrass, fourwing saltbush, and four-part horse brush. Sand dunes occur between 320 and 1,980 m (1,050 and 6,500 ft) in elevation, on young alluvium-colluvium deposits or aeolian sand. They are constantly being eroded and reformed by the prevailing wind which results in sparse plant cover in these habitats. Water is held for long periods of time just under the surface, allowing shrubs to successfully root and persist through long droughts (Nachlinger et al., 2001). Unlike many soils in desert basins, sand dunes are well-drained and non-saline. As a result, their vegetation differs considerably from the surrounding basin or bajada (MDEPT, 2001). Sand dune habitats are dynamic and reliant upon large-scale patterns and ecosystem processes that include wind and sand corridors (Barrow, 1996).

Badlands are found at all elevations, although most commonly on low and moderate elevations, on steep bedrock outcroppings, ridgetops, windswept barrens, or alluvial and colluvial deposits (Nachlinger et al*.,* 2001). Vegetation on badlands is often dominated by unique plant assemblages or by non-vascular lichens and cryptogamic species. Altered andesite soils are a special case of hydrothermally-altered badlands in the western Great Basin with vegetation dominated by relictual conifer species. The conifers are able to maintain dominance over typical Great Basin shrublands and woodlands because of their competitive advantage on the nutrient poor and acidic soils (Billings, 1990). Ecological services provided by badland systems may include serving as natural barriers to weed invasion and fire since they have little vegetation to burn.

Value to Wildlife

Numerous species associated with sand dunes and badlands are endemic to particular locales with unusual biological and physical conditions. Many sand dune systems in Nevada have a high diversity of dune invertebrates including beetles, solitary bees, crickets, and ants, some of which are sand dune obligates (Nachlinger et al*.,* 2001). Terrestrial invertebrates, specifically beetles and solitary bees, are the best studied sand dune animals and many depend on dune vegetation for adult or larval forage, mating sites, and protective cover (Brussard et al., 1998). The population assessment of a common sand dune-obligate beetle, *Eusattus muricatus,* provides insight to managing and conserving these habitats in Nevada. Dunes in smaller, isolated pluvial areas of the Great Basin and Mojave Desert may support genetically unique populations of *E. muricatus* that are not likely to be augmented or rescued by dispersal from dunes in other pluvial basins. For obligate species, sand dunes represent unique, limited habitats that were historically connected during the Pleistocene (Britten and Rust, 1996).

Conditions of sand dune habitat that affect wildlife are partially tied to annual rainfall. For example, annual seed production is positively correlated with rainfall in sand dune habitats. As a result, the diversity of seed-eating rodents and perennial shrubs in these habitats is directly tied to annual rainfall (Brown, 1973). Desert kangaroo rats and kangaroo mice primarily feed on seeds in sand dune habitats but occasional foraging on insects has been documented (Best et al*.,* 1989; Hall, 1946). Desert kangaroo rats are closely restricted to areas where accumulations of wind-driven sand have reached considerable depths (Best et al*.* 1989), whereas edaphic factors control habitat selection by kangaroo mice and they can be found in fine, gravelly soils (O'Farrell and Blaustein, 1974) or areas with fine sand supporting some plant growth (Hall 1946). Sand dune species may burrow in the sand to rest, forage, and build nests. Western banded geckos, desert night lizards, and desert horned lizards feed on insects and spiders in sand dune and badland habitats. Prey-seeking species are drawn to sand dune (e.g., kit fox) and badland (e.g., Sonoran lyre snake) habitats to feed on small mammals, lizards, and other inhabitants.

Key Elements of Sand Dunes and Badlands of Importance to Wildlife

SAND DUNES

Plant Seeds and Burrows

Desert kangaroo rat
Dark kangaroo mouse
Pale kangaroo mouse

Prey Populations
- Desert horned lizard
- Western banded gecko
- Desert iguana
- Long-nosed leopard lizard
- Sidewinder

BADLANDS

Prey Populations
- Burrowing Owl
- Western banded gecko
- Desert night lizard
- Desert horned lizard

Existing Environment

Land Uses

- Motorized recreation – OHVs
- Military mission
- Geothermal power production

Habitat Conditions

Conditions of sand dune and badland habitats in Nevada are influenced mostly by OHV use, which contributes to the loss of vegetation (i.e., wildlife habitat), soil disturbance, and potential transport of noxious weeds in heavy use areas. In 2000, OHVs represented 10% (408,703 visitor days) of the total visitor days for all recreation activities on BLM lands in Nevada (Newmark, et al*.,* 2002), and much of this use was likely concentrated in sand dune and badland habitats. Wildlife habitat conditions in many of Nevada's dune systems have been degraded by repeated vehicle incursions, although most dunes continue to retain connectivity to their sand sources (personal communication, Jan Nachlinger, Director of Conservation Planning, The Nature Conservancy of Nevada, June 2005).

Problems Facing the Species and Habitats

Although various plans are in place to manage ongoing OHV recreation, OHVs still present significant risk to these communities. Studies in other states have documented the loss of vertebrate and invertebrate species richness, a reduction in vertebrate and invertebrate populations, and a disruption of mating behaviors in insects that depend on dune-margin vegetation (Hardy and Andrews, 1979; Luckenbach and Bury, 1983). Additionally, heavy use or misuse of OHVs on sand dune and badland habitats reduces vegetative cover and sets the stage for invasive plant species invasions.

Problems facing hydrothermally altered andesites of the western Great Basin include disturbance of vegetation and soil by OHVs and permanent habitat conversion from urban development (Nachlinger et al*.,* 2001). Geothermal power production may also affect these habitats and their species (Nachlinger et al*.,* 2001). Finally, invertebrate species of sand dune and badland habitats that constitute the prey base for wildlife may be vulnerable to environmental and demographic stochasticity due to the small geographic distributions and disjunct nature of their populations (Brussard et al*.,* 1998). Populations of *E. muricatus* separated by approximately 100 kilometers generally exchange very few migrants and may be genetically isolated (Britten and Rust, 1996).

Predicted Effects of Climate Change

Sand dunes and badlands were not specifically targeted for the habitat climate change analysis which focused solely on vegetative communities, but climate change analysis did indicate that “bare ground” would be increasing as certain vegetation systems were increasingly subjected to annual grass invasion and changes in fire regime. The most impacted biophysical setting was creosote bush/bursage in the Mojave Desert, which, while predicted to increase in acreage as a BpS over the 50-year evaluation period, much of that increase was also predicted to be invaded by annual grasses setting new fire regimes that would slowly take out the shrub layer over time.

As temperature increases and precipitation decreases, the stabilizing vegetation growing on sand dunes is expected to decrease and cause the dunes to be more mobile. An altered sand mobility regime could, in turn, change the character of the ecosystem (Hiza and Begay, 2009). Similarly, the unique plant life supported in the Badlands habitat may decrease due to increased temperature and drought caused by climate change, which may alter the wildlife species depending on those plants.

Possible Wildlife Responses to Climate Change

The conversion of Mojave shrublands to sand dunes does not translate into advantages for the species listed in this chapter, most of which rely on the shrublands around the margins of these featured habitats for thermal and escape cover. The most serious climate change factor affecting dune and badland wildlife would be coping with the rising temperatures. While it is difficult to predict whether temperatures would rise to levels prohibiting wildlife use of these sites completely, what might be expected to be observed first would be an abandonment of the innermost spaces of large-patch dunes and barren lands as wildlife would remain near the vegetated margins and redistribute outward with those margins until barren patches began to intersect and vegetated corridors to disappear. Based on modeling of the creosote bush/bursage BpS, such extreme outcomes did not seem to be of uncommon concern for the first 50 years, especially since predictions indicated that creosote bush/bursage would be picking up acreage through conversion of other types.

Changes to the plant communities associated with badlands were not modeled except for Juniper Savanna (See Lower Montane Woodlands and Chaparral). Wildlife associations with this type are not well understood; therefore predictions were not attempted.

Taking Prescriptive Action

No restoration/preservation strategies were developed for Sand Dunes and Badlands as part of the climate change analysis. Prescriptions for the preservation of the Mojave shrub layer can be found in Mojave Warm Desert and Mixed Desert Scrub.

Priority Research Needs

- The effects of sand dune spatial dynamics on sand dune biological communities
- Relationships of species to edaphic properties of badland habitats
- Ecological effects of OHV use on sand dunes and badlands

- Population status and trend of desert kangaroo rat, dark kangaroo mouse, and pale kangaroo mouse
- The effects of climate change on sand dune ecology.

Conservation Strategy

Goal: Natural biodiversity preserved in endemic-rich sand dune and badland habitats while continuing traditional and contemporary human uses.

Objective: Maintain current range and distribution of dune/badlands Species of Conservation Priority in sand dune and badland habitats through 2022.

"current range and distribution" – no loss of species from currently occupied sites as determined by presence/absence surveys conducted at regular intervals not to exceed five years.

Action: Provide designated-use zones for OHVs in non-sensitive areas.

Action: Avoid or minimize disturbance to wildlife and habitat in sensitive areas.

Action: Increase public outreach; develop and implement guidelines for user capacity at popular recreation sites.

Action: Develop conservation agreements that maintain biodiversity and multiple-uses (e.g., motorized recreation, military mission, geothermal development) in sensitive sand dune and badland habitats.

Action: Designate and manage high biodiversity priority dunes and badlands for conservation protection.

Action: Identify and delineate sand dune habitats within probable dispersal distances of each other, and design management that sustains unique populations of sand dune species in Nevada.

Action: determine population status and trend for desert kangaroo rat, dark kangaroo mouse and pale kangaroo mouse. Develop conservation plans as needed based on results.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	35
Private	23
National Park Service	22
Department of Defense	6
U.S. Bureau of Reclamation	4

Tribal Lands	4
State of Nevada	2
U.S. Fish & Wildlife Service	2
Other	2

Existing partnerships, plans, and programs

- Blowing Sands Mountains Conservation Assessment and Strategy
- Steamboat Hot Springs Conservation Agreement

Federal & State Agencies

- Bureau of Land Management
- National Park Service (Lake Mead National Recreation Area)
- U.S. Fish and Wildlife Service
- Department of Defense (Fallon Naval Air Station)
- Nevada Department of Wildlife
- Nevada Division of Forestry

Other Key Partners

- The Nature Conservancy
- Fallon Paiute Shoshone Tribe
- Walker River Paiute Tribe
- University of Nevada (UNR, UNLV)
- Counties

Focal Areas

Amargosa Desert
Bitter Spring Valley
Black Mesa
Black Mountains
Carson Sink
Hays Canyon Range
Las Vegas Valley
Las Vegas Wash
Lower Meadow Valley Wash
Moapa Valley - East
Moapa Valley - West
Pine Forest Range
Piute Valley
Virgin River Valley

Cliffs & Canyons

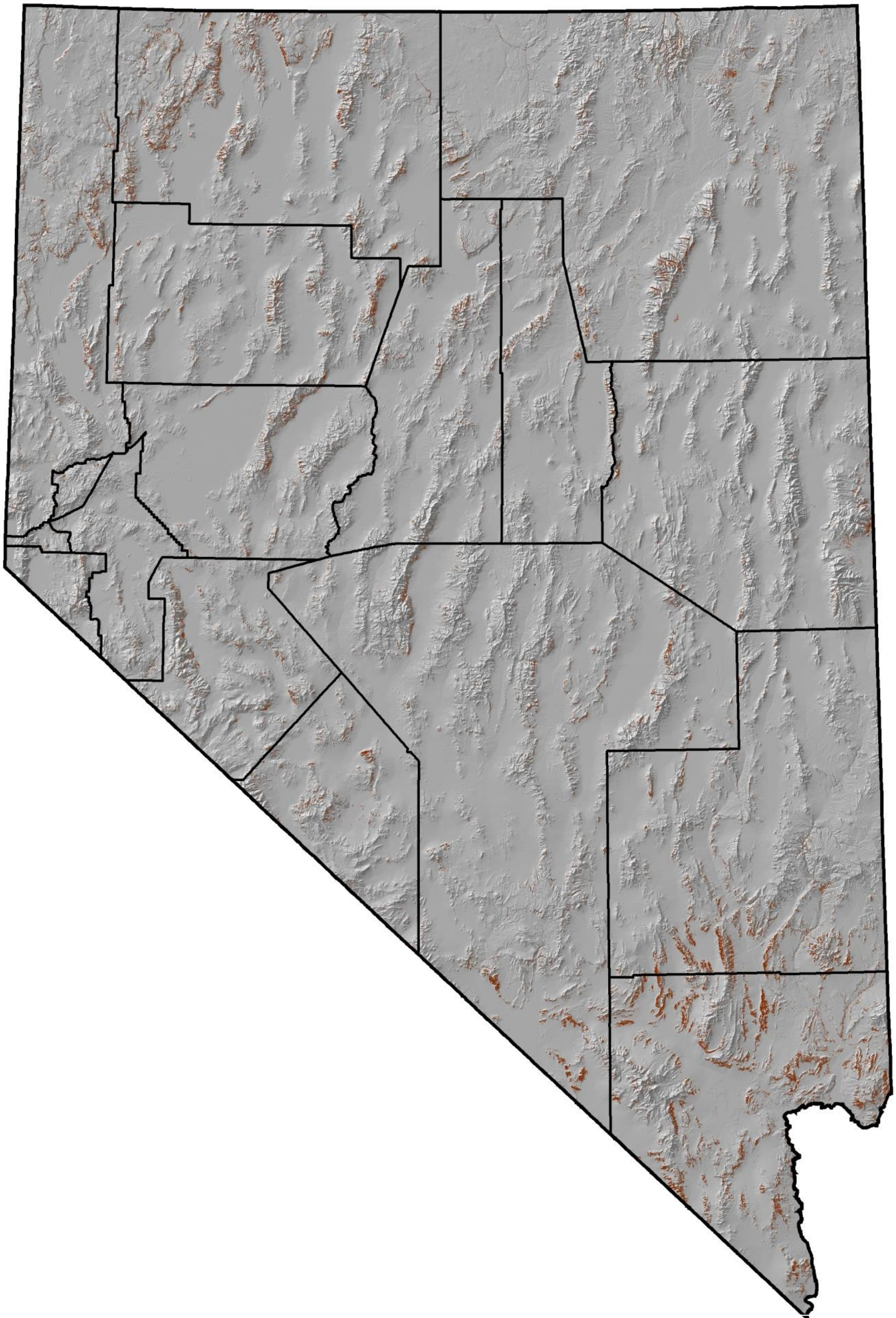


Figure 23: Distribution of Cliffs and Canyons in Nevada.

KEY HABITAT: CLIFFS AND CANYONS

Things to Know….

- Cliff and canyons are vertical or near-vertical cliffs that are sparsely vegetated and comprise of a small fraction of Nevada's total land area.
- Cliff and canyon habitats are important to wildlife as they provide structure for nesting, roosting, or denning; protection from predators; and areas for foraging. Key priority species include Golden Eagle, Peregrine Falcon, and spotted bat.
- Habitat threats include recreation, wind energy development, and mineral extraction.
- Structural aspects of cliffs and canyons are not expected to be impacted directly by climate change.

Ecoregions

Southwest ReGAP 2005

Mojave	197,931 hectares	489,096 acres
Great Basin	159,187 hectares	393,358 acres
Columbia Plateau	95,564 hectares	236,143 acres
Sierra Nevada	533 hectares	1,317 acres
Total	453,215 hectares	1,119,914 acres

Ecological Systems*

SWReGAP Ecological Systems

S007 Sierra Nevada Cliff and Canyon
S009 Intermountain Basins Cliff and Canyon
S010 Colorado Plateau Mixed Bedrock Canyon and Tableland
S016 North American Warm Desert Bedrock Cliff and Outcrop
S019 North American Warm Desert Volcanic Rockland

*TNC biophysical settings were not developed for this key habitat

Key Habitat Description

Vertical and near-vertical cliff lands are scattered throughout Nevada and often harbor unique biodiversity (Nachlinger et al., 2001). These are barren and sparsely vegetated habitats (less than 10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock. Unstable scree and talus slopes typically occur below cliff faces (NatureServe, 2004). Cliffs and canyons are often associated with uplift of normal faults. Cliffs may also occur in steep-sided, deeply eroded valleys and as the edges of eroded remnants of volcanic flows and sedimentary rock outliers at low to high elevations. In Nevada, cliffs range in elevation from the Colorado River canyons (starting at 150 meters in Clark County) to alpine habitats above 4,000 meters on Boundary Peak and Wheeler Peak in northern Nevada (Neel, 1999). Cliff, crevice, and talus habitats are extremely variable but rather simple in nature. Cliffs can be from six meters to over 900 meters high. Talus slopes can be less than a hectare to several thousand hectares in size (Bradley et al., 2004). Due to the linear nature of cliff and canyon habitats, they comprise a relatively small fraction of Nevada's total land area. Since cliffs are at variable elevations and experience a broad range of climatic conditions, dominant plant species can be quite different among these habitats and may include various associations of conifers, shrubs, succulents, lichens, and herbaceous species (NatureServe, 2004).

Value to Wildlife

Cliff and canyon habitats are important to wildlife because they provide structure for nesting, roosting, or denning; protection from predators; and areas for foraging. Most cliffs, crevices, and talus slopes provide suitable maternity and night roosting habitat for bats and nesting habitat for birds in the summer. These sights are generally too exposed to provide significant hibernation roost sites in northern Nevada, but there is strong evidence that rock crevices provide wintering habitat in the Mojave Desert ecoregion in southern Nevada (Bradley et al*.,* 2004). Peregrine Falcons, Prairie Falcons, and Black Rosy-Finches are obligate nesters in cliff and canyon habitats. Falcons and other raptors will nest on cliff ledges, and songbirds will construct nests in crevices. Golden Eagles also predominantly choose cliff faces for nesting in Nevada despite the occasional tree nest or even tall greasewood nest (i.e., Carson Sink). In Nevada, Ferruginous Hawks are more recognized as pinyon/juniper nesters, particularly in the eastern half of the state, but from Battle Mountain and Austin westward, Ferruginous Hawks, in noticeably sparser densities, are more prone to use cliff faces and tufa stacks for nesting substrate. Reptiles use rocks and crevices in cliff and canyon habitat for burrowing, overwintering and protective cover. South and west facing slopes are important areas for reptile brumation, while north and east facing slopes are important for aestivation. Rocks and crevices provide extremely important microhabitats that enable reptiles to thermoregulate, create suitable nests, and escape predators. Rock crevices, boulder piles, or talus are most commonly used by ringtails for denning, while alternative denning habitats are used less often (Poglayen-Neuwall and Toweill, 1988). Pikas also utilize rocky habitats but are obligates of talus slopes containing rock 0.2 to 1.0 meter diameter (Beever et al*.,* 2003). In addition to the structural components provided by cliff and canyon habitats, these areas are valuable to foraging bighorn sheep.

Key Elements of Cliffs and Canyons Habitat Important to Wildlife

LEDGES – nesting substrate, protection from predators

Golden Eagle
Peregrine Falcon
Prairie Falcon
Ferruginous Hawk

CREVICES– nesting, roosting, protection from predators

Black Rosy-Finch
Gray-crowned Rosy-Finch
spotted bat

ROCKY SLOPES– foraging, roosting, protection from predators

American pika
bighorn sheep
gila monster
Sierra alligator lizard
western banded gecko
chuckwalla
Great Basin collared lizard
desert night lizard

CANYON BOTTOMS/RIPARIAN ECOTONE– foraging, migration

Western red-tailed skink
Inyo shrew
mule deer
ring-necked snake
rosy boa
northern rubber boa
Sonoran mountain kingsnake
western threadsnake

Existing Environment

Land Uses

- Non-motorized recreation – rock climbing
- Mineral extraction
- Spring development
- Wind energy development

Habitat Conditions

Recreational rock climbing has increased dramatically over the past 30 years, with southern Nevada receiving the highest recreational climbing levels in the state. Increased human disturbance is expected to have altered some cliff and crevice habitats, yet little research or monitoring has been conducted to determine the degree to which climbing activities have affected cliffs and their associated species (Bradley et al*.,* 2004). Gold mining activities in recent decades have focused on ancient hot springs and seeps that flowed from many of Nevada's cliff faces, resulting in the removal of some cliffs with high microscopic ore content. Some springs at the base of cliffs have been developed for agricultural or urban development (Neel, 1999). Talus habitats, particularly those nearer metropolitan areas, are receiving increased use by rock extraction industries (Bradley et al., 2004). Since 2008, demands for non-petroleum-based energy development have accelerated plans to install wind turbines on ridge tops where wind resources are favorable.

Problems Facing the Species and Habitats

The inaccessibility of cliffs and instability and ruggedness of talus slopes affords some protection to this key habitat and its associated wildlife species, but there are some human influences on cliff and canyon habitats in Nevada. Mineral extraction, recreational rock climbing, and spring development may have localized effects on cliff and canyon habitat (e.g., damage or removal of substrate) or wildlife species (e.g., disturbance during nesting or roosting), but the degree of these effects is unknown. Climbers occasionally abandon climbing equipment and may briefly disturb cliff denizens, but their activities normally do not significantly alter the habitat. In southern Nevada, there is growing concern that recreational climbing associated with a burgeoning urban population is reaching levels sufficient to affect nesting raptors (Neel, 1999).

In addition to human-related problems, species face biogeographic and climatic stresses. Pikas are obligates of discontinuously distributed talus habitat and are potentially at increased risk of predation while foraging or dispersing between habitat patches. Decreased persistence of pika populations in Nevada has been associated with lower elevations which have higher temperatures (Beever et al*.,* 2003); however, recent surveys in the northern part of the state have observed pikas at lower elevations (NDOW, in progress). Currently, mammalian response to climate change includes organism modification of physical characteristics (i.e., phenotypes) and minor adjustments in geographic ranges (Barnosky et al., 2003). Increasing temperatures may result in pikas shifting their range to higher elevations, resulting in changes in population structure and loss of previously suitable talus habitat patches.

While not located in canyons proper, the installation of wind turbine arrays on ridge tops poses threats of collision mortality to resident Golden Eagles, Ferruginous Hawks, and Prairie Falcons as well as the full range of migratory raptors, other migratory birds, and bats using the updrafts from ridge tops and cliff faces for migration assistance. Often, the cliff faces most suitable for raptor nesting are also important structural features in the generation and sustenance of the wind resources necessary for economic wind farm development, thus the potential for conflicts with raptors using the cliffs and updrafts is high.

Predicted Effects of Climate Change

Structural aspects of cliffs and canyons are not expected to be impacted directly by climate change; therefore, the species that are specifically attracted to vertical rock walls or other qualities of rocky substrates are not likely to be impacted by changes to those substrates in and of themselves. It is conceivable that rising ambient temperatures may increase the premium of cliffs and canyons with more complex deep rock/crevice structures that facilitate better cooling capacity. As annual water yield and flow are impacted (particularly in non-carbonate geology), the quality of the canyon bottom ecotone with the riparian zone may be impacted by alterations in high flow regimes, number of days of duration of mesic microhabitats, sumps, seeps, possibly even vegetation changes.

Possible Wildlife Responses to Climate Change

As the streams flowing through canyons approach more of a desert wash character and less of a constant-flow stream, the canyon bottom guild of species may find less suitable habitat in quantity, quality, and duration. None of the species listed in this guild are particularly rigid in their ability to cope with new conditions or move to more suitable areas with the possible exception of Western red-tailed skink.

The persistence of shade in cliffs and canyon habitats, at least for part of the day, may prove to attract species forced to make adjustments by the loss of shrub overstory on the benches above and below the fractured canyon zone, particularly in the Mojave shrub communities. Preliminary if not permanent shifts in distribution from benches and bajadas into the canyons may be the first signal to biologists and land managers that vegetation changes are beginning to impact species distribution and survival.

Priority Research Needs

- Roosting requirements, microhabitat preferences, and general distribution of cliff, crevice, and talus roosting bat species; nightly and seasonal movements of bats from roost to roost (Bradley et al. 2004)
- Population data on cliff-nesting birds in Nevada and population status of Black Rosy Finches (Neel 1999)
- Long-term studies to explain factors contributing to pika extirpation in Nevada that partition natural variability more clearly from anthropogenic influence (Beever et al. 2003)
- Continue various life history studies on Sonoran mountain kingsnake
- Population status and ecology of gila monster
- Population status and ecology of rosy boa

- Population resiliency to harvest pressure for Great Basin collared lizard, chuckwalla, and western banded gecko

Conservation Strategy

Goal: Cliff and canyon habitats capable of sustaining wildlife dependent on the substrate and features for breeding, roosting, denning, and hiding cover, with disturbance during seasons of use kept within sustainable levels.

Objective: Maintain cliff-nesting raptor populations at stable or increasing trend through 2022.

"cliff-nesting raptor" – Golden Eagle, Ferruginous Hawk, Prairie Falcon, Peregrine Falcon
"stable or increasing trend" – as determined via NDOW nesting raptor surveys conducted at regular intervals not to exceed five years.

Action: Continue helicopter surveys of cliff-nesting raptors to keep knowledge of current nest activity, landscape-scale distributions, and responses to wind energy development up-to-date and relevant to wind energy conservation mitigation discussions.

Action: Participate in national and regional Golden Eagle population management efforts for the purpose of informing development of "acceptable take" numbers in the USFWS programmatic take permitting process for Golden Eagles in compliance with Bald and Golden Eagle Act requirements.

Action: Continue to report Peregrine Falcon nest occupancy results to USFWS in compliance with post-delisting requirements.

Action: Support and advocate technological research intended to develop non-lethal wind turbine designs to minimize collision mortality of raptors, other migratory birds, and bats.

Action: Apply appropriate conservation protection to important nesting and roosting sites in cliffs, crevices, and talus habitat.

Objective: Maintain bighorn sheep and mule deer at current distribution with stable or increasing trend through 2022.

"current distribution" – no loss of distinct occurrence locations
"stable or increasing trend" – as determined by NDOW big game surveys conducted annually.

Action: Provide adequate disturbance protection to cliffs and canyons in key lambing and fawning areas.

Action: Minimize contact between bighorn sheep and domestic sheep in cliff/canyon habitats.
Action: Ensure adequate water availability in association with key cliff/canyon habitats through diligent water source inventory and enhanced water development techniques.

Objective: Maintain American pika populations at current distribution through 2022.

"current distribution" – no loss of distinct occurrence locations as monitored by occupied site survey conducted at regular intervals not to exceed 10 years.

Action: Implement a statewide American pika occupancy monitoring program that verifies activity at known American pika sites.

Action: Continue to inventory new pika sites based on new understanding of the range and habitat preferences of the northwestern Nevada subpopulation.

Objective: Maintain chuckwalla, Great Basin collared lizard, and western banded gecko at current distribution with stable or increasing trend through 2022.

"current distribution" – no loss of distinct occurrence locations
"stable or increasing trend" – as determined by appropriate survey method conducted at regular intervals not to exceed five years.

Action: Implement regular population monitoring programs for reptile species of high collection volume with the intent of developing statistically robust, responsive population status and trend estimates.

Objective: Maintain mammals and reptiles of conservation priority at detectable levels in cliff/canyon habitats through 2022.

"mammals" – Inyo shrew; spotted bat
"reptiles" – gila monster; desert night lizard; Western red-tailed skink; ring-necked snake; rosy boa; northern rubber boa; Sonoran mountain kingsnake; western threadsnake
"detectable levels" – as determined by appropriate surveillance surveys conducted at regular intervals not to exceed five years.

Action: Conduct appropriate surveys for reptiles of conservation priority, including Gila monster, rosy boa, Sonoran mountain kingsnake and Western red-tailed skink.

Action: Initiate discovery surveys for rosy boa in southern Nevada to follow up on first published state record from 2011.

Action: Develop priority amphibian and reptile conservation areas (PARCAS) using Partnerships for Amphibian and Reptile Conservation (PARC) criteria for integration into local and federal land use planning and conservation design.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	64
U.S. Forest Service	10
Department of Defense	8
U.S. Fish & Wildlife Service	7
Private	6
National Park Service	4
Tribal	1
Other	<1

Existing partnerships, plans, and programs

Multi-partner

- Nevada Bat Working Group/Nevada Bat Conservation Plan
- Cooperative agreement between Las Vegas Climber's Liaison Council and BLM's Red Rock Canyon National Conservation Area
- Spring Mountains National Recreation Area Conservation Agreement

Federal & State Agencies

- Bureau of Land Management:
- U.S. Forest Service:
- U. S. Fish and Wildlife Service:
- National Park Service
- Nevada Department of Wildlife

Conservation Organizations

- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society
- Sierra Club

Bird Initiatives

- Partners In Flight North American Land Bird Conservation Plan
- Nevada Partners In Flight

Other Key Partners

- Counties
- Great Basin Bird Observatory
- HawkWatch International

Focal Areas

- Black Mountains
- Black Rock Range
- Buffalo Hills
- Calico Mountains-Pershing
- El Dorado Mountains
- Granite Range
- Hays Canyon Range
- High Rock Area
- Independence Mountains
- Jarbidge Wilderness
- Las Vegas Valley
- Madelin Mesa
- McCullough Range
- Montana Mountains
- Muddy Mountains
- Pancake Range
- Pine Forest Range
- Ruby Mountains
- Santa Rosa Range
- Sheldon NWR
- Shoshone Range
- Silver Peak Range
- Snake Mountains
- Snake Range
- Spring Mountains
- Toiyabe Range
- Trout Creek Mountains
- Tuscarora Mountains
- Virgin River Valley
- Wassuk Range

Fire Canyon Photo Courtesy of P. Conrad

Caves & Mines

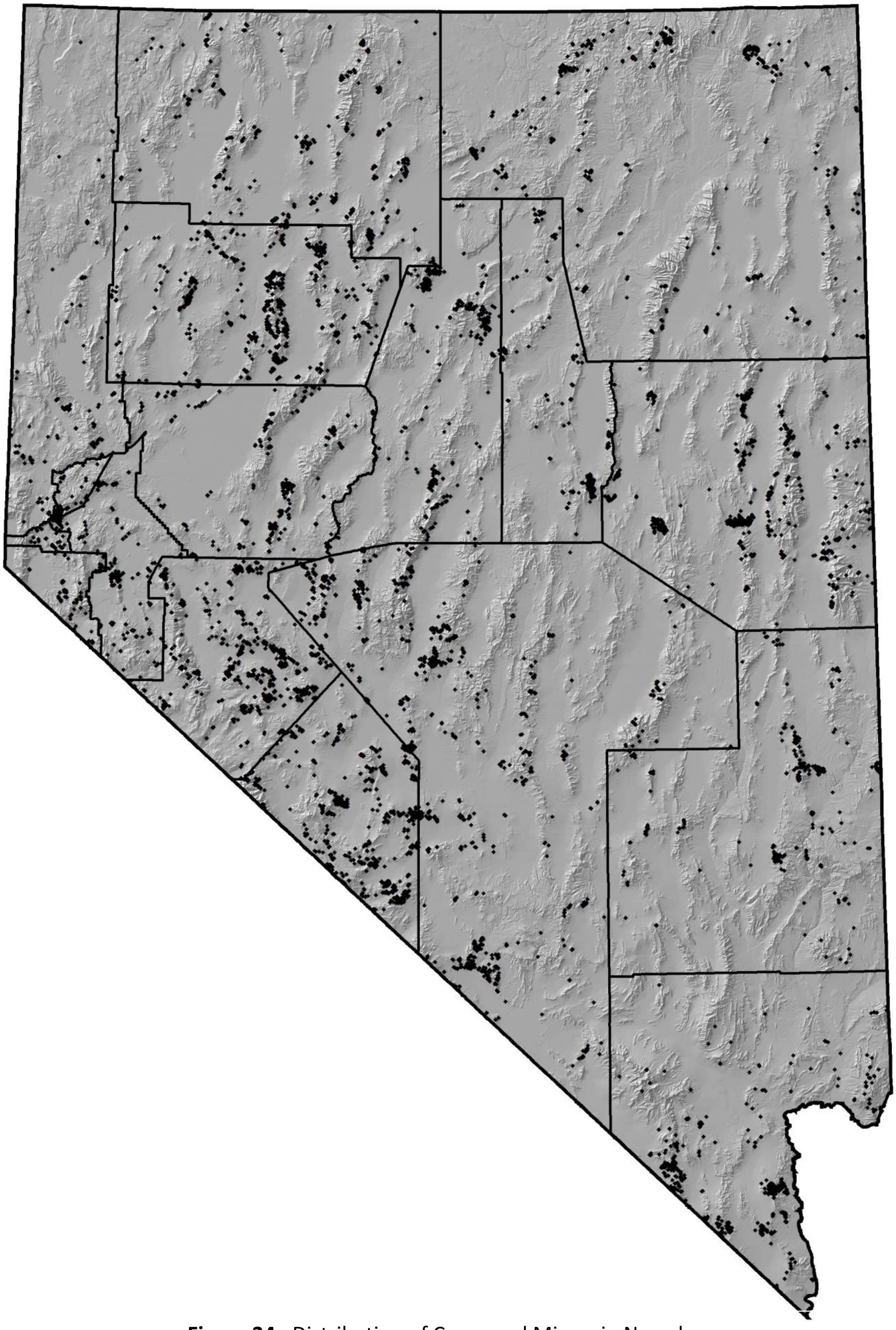


Figure 24: Distribution of Caves and Mines in Nevada.

KEY HABITAT: CAVES AND MINES

Things to Know….

- Caves and mines are found throughout Nevada but are the rarest of wildlife habitat types.
- Provides roosting sites for 19 species of bats and several bird species. Key priority species include Townsend's big-eared bat, Allen's big-eared bat, and Black Rosy-Finch.
- Key threats include disease, disturbance, and loss of cave or mine.
- These underground habitats are more or less insulated from temperature change above ground by overlying rocks and soil.

Ecoregions

Caves and mines are found in all of Nevada's ecoregions in a variety of ecological systems. It is not currently possible to provide an estimate of numbers or aerial extent of caves and mines.

Key Habitat Description

Natural caves are found throughout Nevada. The highest concentration of caves is in sedimentary deposits, particularly those where limestone solution processes have carved caverns in the parent rock. Igneous deposits, primarily volcanic deposits, also contain a substantial number of natural caves or hollow tubes formed by flowing lava and natural fracturing. Metamorphic parent rock types provide the lowest number of natural caves in Nevada although fracturing occasionally produces suitable cave formations (Bradley et al*.,* 2004). Terrestrial and aquatic habitats are present in caves. Terrestrial habitats are typically composed of flood debris (including logs, twigs, and leaves from the surface), animal feces, clay floors, rocky floors, and bedrock walls and ceilings. Aquatic habitat may be comprised of streams, springs, or drip pools.

Historic and active mines are also found throughout the state wherever hard rock mining districts occur. Historical mine distribution does not mirror natural cave distribution and occurs in almost all rock types. As compared to the surrounding landscape, caves, shafts, and adits are the rarest of all wildlife habitat types in the Intermountain West and likely comprise less than one percent of the total habitat available (Bradley et al*.,* 2004).

Cave, shaft, and adit (horizontal mine workings) habitats range in elevation from 150 meters along the Colorado River to near 4,000 meters on Boundary and Wheeler peaks in northern Nevada and can be simple or complex. In complex systems, warm air traps can vary from 20-30°F below outside ambient temperature in the summer or above outside ambient temperature in the winter. Multiple entrances can result in greater air flow into and through the structure affecting the internal microclimate. Geothermal heating can also affect internal microclimate. With the exception of algae growth in some artificially lighted caves, plants do not occur in this habitat type. Plant composition at surface openings varies with elevation, precipitation, latitude, and longitude (Bradley et al., 2004).

Value to Wildlife

Tunnel mines that were excavated since the mid-1800s provide potential roosting sites for 19 of Nevada's bat species although relatively few support significant colonies (Brussard et al., 1998). There are a number of historical mining fixtures in Nevada; however, many are not used by bats due to a variety of factors such as lack of available shelter, unsuitable microclimate, and human disturbance. Because they are not widely distributed across the landscape, suitable subterranean habitats (e.g., caves and mines) for roosting bats are particularly valuable.

As mentioned above, cave, shaft, and adit habitats can be simple or complex. The longer adits and those with a greater number of vertical and horizontal connections to the surface are generally the more complex habitats and seem to be preferred by bats, especially for hibernating and maternity sites. Simple structures can also be very important and are necessary for several species during certain parts of their life cycles (Bradley et al*.,* 2004). Bats utilizing subterranean habitats are not the only species that may benefit from the shelter provided by these habitats. Mines, caves, and crevices are the preferred winter roosts of Black Rosy-Finch and Gray-crowned Rosy-Finch. Desert tortoises have been found "inhabiting" adits, and Say's Phoebe, swallows, and Barn Owls have all been observed nesting and occupying mines (Durbin and Coyner, 2004; personal communication, Jennifer Newmark, Administrator, Nevada Natural Heritage Program, December 2011).

Nevada's cave systems provide habitat for several obligate invertebrate cave dwellers that are restricted to these environments throughout their life cycle. These obligate species include two aquatic amphipods (*Stygobromus lacicolus* and *S. tahoensis*), a harvestman (*Cryptobunus ungulatus ungulatus*), a pseudoscorpion (*Microcreagris grandis*), and a bristletail (*Condeicampa langei*) (NNHP, 2004; Peck, 1998). The harvestman and pseudoscorpion are on the Nevada Natural Heritage Program's at-risk species list. Because of the extreme isolation, uniqueness, and harsh conditions of the cave environment, many of the species that occur there are rare.

Key Elements of Caves and Mines Habitat Important to Wildlife

ROOSTING

Allen's big-eared bat
California leaf-nosed bat
cave myotis
fringed myotis
little brown myotis
Townsend's big-eared bat
western small-footed myotis
long-eared myotis
Black Rosy-Finch
Gray-crowned Rosy-Finch

DENNING/THERMOREGULATION

gila monster
desert tortoise

Existing Environment

Land Uses

- Mineral/resource extraction
- Non-motorized recreation – caving
- Scientific research

Habitat Conditions

Urban and rural population growth in the last several decades, particularly in western and southern Nevada, has prompted a dramatic increase in human exploration of caves and abandoned mines. As such, increased human disturbance in the form of non-natural light sources, elevated noise levels, soil and structure disturbance, and vandalism have altered many of these habitats (Bradley et al., 2004).

Nevada's geology provides ideal conditions for the deposition of a large variety of valuable and useful minerals, and miners and prospectors have been attracted to these minerals for over 150 years. Many of the mine openings left behind by miners and prospectors have become unstable because of exposure to environmental elements and decay of support timbers. Internal features of historic mines can also deteriorate and become very unstable and dangerous. Of the estimated 200,000 to 300,000 mining-related features in the state, the Nevada Division of Minerals estimates that 50,000 are significant hazards that require some type of securing. The State of Nevada's Abandoned Mine Lands program has been proactive in working to prevent human injuries or fatalities related to abandoned mine hazards since 1987. Securing hazards includes backfill and foaming projects across the state which permanently eliminates mine openings for wildlife use (Durbin and Coyner, 2004). Since 2004 the cooperative efforts of Nevada State Division of Minerals, Bureau of Land Management, U.S. Forest Service and Nevada Department of Wildlife have resulted in the closure of nearly 1500 mine hazards after bat resource assessments were made. Of those closures, over 450 have been made using bat-friendly techniques that preserved the important nature of the site to bat use.

Problems Facing the Species and Habitats

Their large colonies, low birth rates, high infant mortality, high roost fidelity, and long life spans make most bat populations vulnerable to human and natural disturbances in roosting and foraging habitat. Most bats are very sensitive to disturbance and will readily abandon a site, and even their young, if disturbed. Disturbance during hibernation can cause bats to awaken prematurely which is energetically very expensive. The resulting decrease in body fat reserves can cause the bat to die of starvation during hibernation. Many bats are directly killed by humans out of fear and misunderstanding, and in some cases roosts are destroyed in an effort to eradicate a colony of bats.

Contemporary open-pit mining operations are often located in historical mining districts. In situations where historical adits and shafts are carved away by the expansion of an open-pit mine, these habitats are lost permanently. In other areas adjacent to renewed mining, disturbance to foraging areas and direct disturbance to bats can cause serious declines in populations, alter species composition or cause an entire roost to be abandoned. Some effective mitigation in these situations has occurred (Bradley et al*.,* 2004). Recreational caving, guano harvest, and to a lesser extent, scientific fieldwork (i.e., inventory, monitoring, and scientific research) can be disruptive during critical stages in the life history of bats, particularly maternity and hibernation periods (Bradley et al*.,* 2004; Pierson and Brown, 1992). Some eradication projects designed to protect the public from rabies transmission have been implemented (Bradley et al*.,* 2004). Fear and misunderstanding of bats creates a public perception that these animals are not beneficial and are dangerous, creating a direct threat to species survival.

In 2006, a new threat to subterranean-roosting bats was discovered in bat hibernacula in New York State – a fungal infection now known as "White-nose Syndrome." Since its discovery, the sickness has spread to 18 states and killed more than a million subterranean hibernating bats. Researchers have identified the causative agent as *Geomyces destructans*, a fungus new to science. Since the discovery and state-by-state onslaught of this deadly disease, decontamination protocols to reduce the transmission of the fungus, surveillance strategies, and diagnostic procedures have been developed. As of this writing, White-nose Syndrome had not yet been discovered in Nevada.

In 1983 a new source of songbird mortality in Nevada was identified – one that is closely tied to mining activities. Cavity-nesting birds were entering and becoming trapped in hollow, plastic mine claim markers. Work to date has shown that hollow mine claim markers represent a substantial mortality factor for several cavity-nesting and non-cavity nesting species that occupy Nevada for at least part of their life cycle.

The scale of this problem has been documented over numerous years during mine claim marker removal projects. A total of 43 species mortalities have been documented including four species identified in the Nevada Wildlife Action Plan as Species of Conservation Priority. Recent legislation, (NRS 517.030) allows the removal of all extant, standing, plastic hollow mine claim marker posts and to deposit them in a horizontal position on the ground at the site of removal.

Predicted Effects of Climate Change

To a certain extent, the suitability of subterranean sites provided by Nevada's caves and abandoned mines for bat roosting and hibernation is maintained by the site's relatively constant internal "climate," at least during the traditional time of bat use. These underground habitats are more or less insulated from temperature change above ground by overlying rocks and soil. Seasonal fluctuations of temperature are minimized and the effects of local temperature change are likely to be less than and lag well behind surface temperature changes, but as The Coast and Wetlands Society (Inc.) of Australia warned an Australian House Standing Committee on Climate Change, Environment and the Arts, *"This does not mean that subterranean habitats and their biota will be immune from the effects of climate change as changes to rainfall patterns will have impacts and these could be spread out over very long periods of time."* The technology and understanding to be able to predict what those effects might be and how long they might be in taking effect is not available to us at the current time.

Possible Wildlife Responses to Climate Change

Wildlife species using caves and mines as an important element of their natural history are most likely to experience the impacts of climate change outside their subterranean refuges before inside. Initial impacts to insectivorous bats would be expected to come from changes in insect diversity and quantity that might be counter to current dietary preferences and/or necessary available biomass. The following comes from a USGS webpage "Impacts of Climate Change on Life and Ecosystems" (Bogan, 2003):

> *"In temperate latitudes, both northern and southern, bats avoid seasonal food shortages by either hibernating, often in caves or mines, or by migrating to regions where food is still available. We suspect that nearly all attributes of hibernation or migration are mediated by combinations of changes in ambient light regimes, temperature, and food resources. The dependence of temperate-zone bats on the interplay of these factors ultimately revolves around the bats' ability to acquire sufficient energy (in the form of food) to either last them through a hibernation sequence or through the rigors of (sometimes) long-distance migration. Temperature changes that would affect the supply of food to bats or otherwise upset an energy balance that has evolved over millennia should have significant consequences for bats. Also, climate changes that would lead to changes in the internal temperatures of roosts that have been used by bats for decades will force bats to locate and use new or different roosts."*

Currently, there are little or no empirical data from which functional models yielding predictions could be built.

Priority Research Needs

- Information on life history, population status and trend, location of key concentrations, and conservation needs of caves and mine roosting bats.
- Individual movement patterns between seasons, specific roost requirements, microclimate needs, frequency of roost shifting, winter hibernacula preferences, and locations of significant colonies of priority bat species.
- Use of caves and mines for roosting and foraging (particularly for the long-eared myotis), migration staging sites, and lekking sites.
- Population status and trend of Black Rosy-Finch
- Population status, distribution, and ecology of gila monster
- Extent of use by desert tortoise

Conservation Strategy

Goal: Healthy, secure wildlife communities in structurally intact subterranean habitats, including natural caves and fissures with naturally functioning hydrologic processes; and the diversity of artificially created habitat features associated with mines

Objective: Through continued collaboration with Nevada Division of Minerals, BLM, and USFS, conduct 200 mine feature assessments per year and install 50 bat-friendly closure structures per year through 2022.

"mine feature assessments" – internal/external bat surveys
"bat-friendly closure structures" – bat gates or cupolas that allow the free ingress and egress of bats from a mine feature.

Action: Continue the proper evaluation of subterranean mines destined for closure activities as wildlife habitat prior to closure in appropriate season and weather conditions.

Action: When possible, retain wildlife habitat by selecting alternative mine closure methods such as hazard signs, fencing, and/or properly designed bat gates.

Action: Develop and implement temporal and spatial use recommendations in known nesting, nursery, or other roost areas that will minimize disturbance to wildlife by recreational cavers, guano harvesters, prospectors, or scientists.

Objective: Maintain stable or increasing populations of priority bats associated with caves and mines through 2022.

"stable or increasing populations" – as determined by ANABAT presence/absence surveys or other appropriate surveys conducted at regular intervals not to exceed five years.

Action: Initiate a statewide, statistically robust ANABAT surveillance survey network to systematically monitor presence/absence of priority bat species.

Action: Initiate a White-nose Syndrome surveillance monitoring network with emphasis on early detection and triggered conservation/regulation response.

Action: Actively participate in national and regional White-nose Syndrome working groups.

Action: Identify and properly survey caves and mines that are potential habitat for wildlife and document the comprehensive distribution of these habitats and their species.

Action: Identify and map key hibernation, maternity, bachelor, staging, leking, and night roost sites in caves, mine shafts, and adits that either currently support or have historically supported populations of bats.

Action: For sites with substantial bat use, develop coordinated protection plans with local entities and responsible parties.

Action: Where protection of key cave or mine roosting sites is not an option, explore mitigation possibilities such as designing and constructing alternate roost sites. Implement proper exclusion methods prior to site disturbance, alteration, or permanent closure.

Action: Create and implement a public outreach program focused on the conservation of cave and mine habitats and their associated species.

Objective: Guide habitat restorations efforts to reduce the number and density of mine claim markers across the landscape to restore natural habitat and reduce indirect mortality to Species of Conservation Priority through partnership with conservation organizations and volunteers.

Action: Actively participate in mine-claim marker removal projects and efforts with various key partners.

Partnerships

Land Management/Ownership of recently mined or quarried lands in Nevada

Ownership statistics for mines and natural caves are difficult to summarize. Data layers are being compiled to address this information need.

Existing partnerships, plans, and programs

Multi-partner

- Abandoned Mines Program
- Abandoned mines cooperative agreement between Bureau of Land Management and Nevada Division of Minerals
- Spring Mountains National Recreation Area Conservation Agreement

Bat Conservation Initiatives

- Nevada Bat Conservation Plan

- Western Bat Working Group
- Bat Conservation International

Federal & State Agencies

- Bureau of Land Management
- U. S. Forest Service
- National Park Service
- Nevada Department of Wildlife
- Nevada Division of Minerals
- Nevada Natural Heritage Program

Other Key Partners

- Counties

Townsend's Big-eared Bat Photo Courtesy of N.M. Public

Developed Landscapes

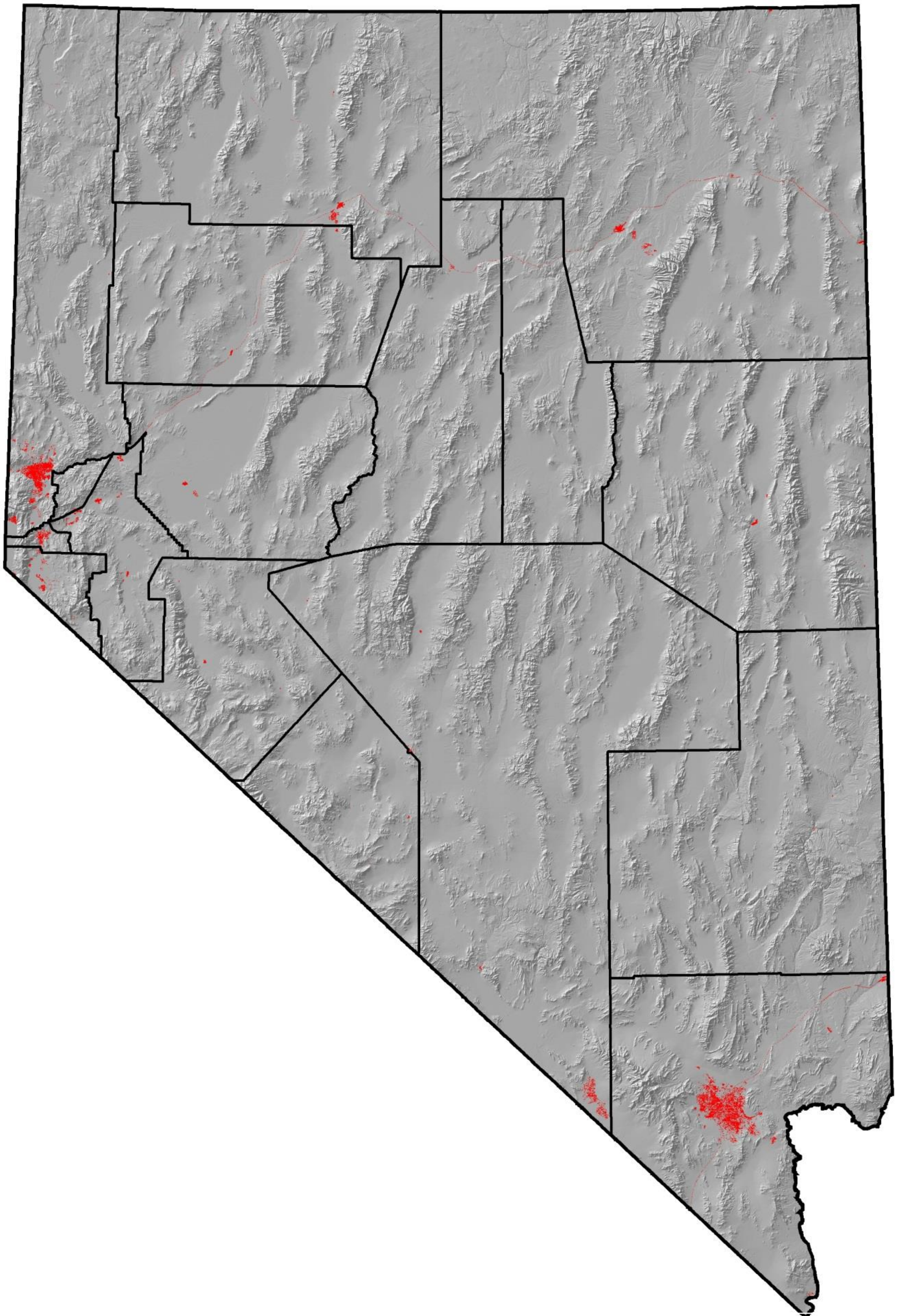


Figure 25: Distribution of Developed Landscapes in Nevada.

KEY HABITAT: DEVELOPED LANDSCAPES

Things to Know….

- Developed lands consist of residential lots, urban, and industrial areas.
- Developed lands do provide some habitat value to a variety of species, such as Peregrine Falcon.
- Habitat threats include direct mortality, predation, disease, and human conflicts.

Ecoregions

Southwest ReGAP 2005

Mojave	48,166 hectares	119,020 acres
Great Basin	43,628 hectares	107,855 acres
Sierra Nevada	1,404 hectares	3,470 acres
Columbia Plateau	402 hectares	993 acres
Total	93,600 hectares	231,338 acres

Ecological Systems*

SWReGAP Ecological Systems

N21 Developed, Open Space-Low Density
N22 Developed, Medium-High Density

*No TNC biophysical settings developed for this group

Key Habitat Description

Developed lands generally fall into two recognizable categories each of which offers its own set of challenges and opportunities to wildlife. Open space-low density developments are generally suburban in nature and consist primarily of residential lots of varying size with school grounds, athletic fields, golf courses, and parks interspersed throughout. Residential lots are generally single-family homes with yards varying from roughly a quarter-acre (0.10 hectare) to one acre (0.40 hectare) or more, but (except for the most upscale neighborhoods) rarely exceeding five acres (2.0 hectares). Yards are typically converted to lawn trimmed with ornamental shrubs, trees, and flower beds. Ball fields, school yards, and parks are generally open and converted to lawn to varying degrees with scattered ornamental trees, resembling tiny patches of irrigated savanna. In desert areas where water availability is becoming of increasing concern, the pattern of planting yards to lawn is being discouraged in favor of xeriscaping (landscaping with rock and desert vegetation requiring little or no water). A sudden addition to this category includes the large number of graded developments where housing was to be developed, vegetation has been removed and lots have been graded to some degree. No structures are present in these areas and the sites have become fallow sites where weeds have become established.

Medium-high density development is generally urban or industrial in nature and is characterized by almost complete site construction with very little soil substrate left open to support vegetation. Grounds are mostly paved with asphalt or concrete. Buildings are generally industrial, commercial, and/or high-rise, ranging in height from single-story commercial buildings 6m (20 ft) high to skyscrapers nearing 200m (650 ft) high. Commercial buildings generally start at about one half-acre (0.20 hectare) in area, and warehouses, factories, and casinos can cover dozens of acres. The cumulative effect of commercial/industrial development can cover hundreds of acres. Vehicular traffic through these lands is typically high-volume throughout the day. Noise and artificial night light levels are elevated around the clock.

Value to Wildlife

While the conversion of native habitat to developed lands creates many adjustment challenges for the native wildlife community and most often results in the eventual eviction of the native wildlife community, developed landscapes are nonetheless repatriated by a new wildlife community capable of exploiting the ancillary benefits of human civilization. Wildlife populate open space and make do and sometimes even flourish with the resources provided by shade trees, covered porches or garages, lawn irrigation, pools, ornamental shrubs and rock walls, and flower gardens. Predator species also take advantage of the prey species attracted to these urban resources. Along the wildland-surburban interface, coyotes prey on pets and eat dog food left on the back porch; black bears, raccoons, and mustelids rummage through garbage cans and dumpsters for food, and mule deer graze on flowers, ornamental shrubs, and fruit trees. In many cases the wildlife are considered a nuisance. Many species of songbirds are able to live in suburban environments as long as the surrogate plant communities are in place and somewhat extensive in the aggregate. Park and golf course ponds become popular loafing spots for ducks, Canada Geese, and other water birds including fish-eating birds when fish are present. Even high-rise buildings and bridges are not totally bereft of wildlife. Some species of bats have become quite acclimated to roosting in expansion grooves under bridges or in crevices or under verandas on high-rise hotels, and apartment buildings. Even Peregrine Falcons have exhibited an ability to adapt to urban development and have learned to treat secluded “ledges” on the sheer sides of skyscrapers as nothing more than a stylized version of a granite cliff. The wildland-urban interface is often a patchwork of developed, undeveloped, and initially disturbed open lots in which the native wildlife community can still operate, although under decidedly elevated risk. Horned lizards and other reptiles can still find their way into suburban open space through corridors leading to the wildland margin, and even bighorn sheep will venture from their mountain habitats under the cover of evening to graze on prime golf course and park grasses where they occur at the wildland interface. Oftentimes, residents on the edge of the suburban-Mojave Desert interface report finding a desert tortoise that has wandered into their yard. As with most other wildlife, desert tortoises are attracted to water, food and shelter that are so often provided in suburban backyards.

Key Elements of Developed Landscapes Important to Wildlife

URBAN/SUBURBAN PONDS – resting, foraging

Northern Pintail
Redhead
Canvasback
northwestern pond turtle
water shrew

BUILDINGS/BRIDGES – nesting, roosting

Peregrine Falcon
little brown myotis
pallid bat

GOLF COURSES – foraging

Western Burrowing Owl
bighorn sheep

mountain pocket gopher
Gila monster

BACKYARDS – nesting structure, thermal cover, foraging
Rufous Hummingbird
Scott's Oriole
Mountain Quail
mule deer
western banded gecko
desert horned lizard
desert tortoise
Gila monster

Existing Environment

Land Uses

- Motorized recreation
- Non-motorized recreation
- Utility rights-of-way
- Urban/suburban development
- Industrial Development
- Road development
- Waste and hazardous materials disposal

Habitat Conditions

Habitat conditions in developed landscapes are not comparable to those that existed on these landscapes prior to their development. However, there are distinct differences in habitat conditions among the various developed landscape types. Suburban habitats can be enhanced by the judicious selection of wildlife-friendly landscaping vegetation, and many states have invested significantly in urban wildlife programs that provide consultation and technical expertise to urban and suburban landowners interested in upgrading their residential lot for wildlife. Generally speaking, suburban landscapes are friendly to the usual wildlife community adapted to successfully exploiting it, while urban landscapes exhibit elevated risk and hostility to wildlife trying to establish within them. A few exceptions, mentioned above, exist, but for the most part it is much more difficult for urban landscapes to support wildlife communities of significant diversity than it is for suburban areas.

Problems Facing the Species and Habitats

Despite the positive aspects discussed above, it must be recognized that despite the fact that maintenance of developed landscapes results in productive urban wildlife habitats, the native wildlife diversity and habitats that once existed there have been lost. Also, as alternative water supplies are sought, acquired, and developed to support Nevada's urban population growth, native wildlife communities dependent upon reliable water sources elsewhere in the state may be adversely affected.

Wildlife in urban and suburban landscapes are at constant elevated risk to predation by domestic pets, disease transmission at popular concentration centers, traffic and picture window collision mortality, contamination by pollutants, exposure to household pesticides, and a host of threats associated with the artificial human environment. Wildlife also come into conflict with humans over a host of lifestyle issues – e.g., venomous reptiles attracted to water and shade, wild ungulates consuming garden plants, herons and other species feeding on domesticated pond flora and fauna, waterfowl inflicting damage on golf course turfs and private swimming pools, and wildlife making their way into residences and inflicting damages on property and household goods. Interactions and conflicts between wildlife, humans, and their properties, in developed landscapes will continue to increase concerns regarding human safety and property damage. As a result, societal acceptance of living in proximity to wildlife is likely to diminish over time.

Priority Research Needs

- Methods of wildlife extension that enable residents to "handle" their own wildlife problems through the management of the environmental parameters that create wildlife conflicts in developed landscapes.
- "Values/Willingness to Pay" marketing research to determine the willingness of urban/suburban residents to contribute to the administration of fully-developed extension and wildlife control programs through various proposed funding mechanisms
- Assess potential impacts of captive pet desert tortoises on wild desert tortoise populations and recovery.

Conservation Strategy

Goal: Thriving wildlife communities adapted to productive urban/suburban landscapes.

Objective: An increase in the public perception of the value of wildlife as a "quality-of-life" indicator in urban/suburban landscapes by 2022.

Action: Develop an urban/suburban wildlife extension program that assists residents with the full array of wildlife-related issues, including voluntary habitat enhancement, proactive wildlife conflict management, and "living with wildlife" outreach elements.

Action: Develop and expand urban trail networks, interpretive centers which will promote understanding and acceptance of Nevada's wildlife.

Action: Develop partnerships with city and county governments that promote the purchase and preservation of open space as wildlife habitat.

Action: Provide Wildlife Action Plan support to city and county open space planning efforts such as River Walk corridor development, park design and interpretation, wetland wildlife viewing facilities, etc. through active participation in steering committees and provision of "watchable wildlife" planning services and products.

Action: Partner with agencies and municipal entities to sponsor wildlife watching events such as the Spring Wings Festival, etc. Work with local and state tourism personnel, and identify and initiate at least one major wildlife watching event in the Eastern Region and the Southern Region to promote economic development.

Action: Develop Watchable Wildlife recreation facilities on NDOW Wildlife Management Areas.

Objective: Decrease public wildlife complaints and decrease on-site call responses by 2022.

Action: Continue to develop an urban/suburban wildlife extension program that assists residents with proactive wildlife conflict management and "living with wildlife" outreach elements.

Action: Continue to develop a coordinated, wildlife control program that responds to calls of necessity promptly, deals with the situation forthrightly and professionally, and takes the opportunity to turn contacts with the public into positive experiences.

Action: Develop and implement a public outreach program that identifies the value of wildlife and agency services in developed landscapes and explore ways to garner public support for funding of these services.

Objective: Decrease the number of unwanted pet desert tortoises significantly by 2022.

Action: Educate and provide outreach to desert tortoise custodians on legal acquisition of a pet desert tortoise, appropriate habitat and escape-proof yard, regulations pertaining to desert tortoises, and discourage breeding and encourage the possession of one male desert tortoise per household.

Action: Consider appropriate regulations to decrease the numbers of unwanted pet desert tortoises.

Action: Develop a funding mechanism to pay for the care and disposition of unwanted pet desert tortoises.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Private	83.2
Bureau of Land Management	10.1
Other	1.6
Bureau of Reclamation	1.4
County Lands	1.4
Department of Defense	1.2
City Lands	1.1

Existing partnerships, plans, and programs

- Wild Animal Infirmary For Nevada
- Wild Wings
- Desert Tortoise Adoption Program
- Desert Tortoise Hotline and Pick Up Service

Federal & State Agencies

- Nevada Department of Wildlife
- Nevada Department of Agriculture
- Nevada Division of Forestry
- USDA Wildlife Services
- U.S. Fish and Wildlife Service

Counties/Cities

- Clark, Washoe, Douglas, and Lyon Counties
- County Parks and Recreation
- Municipal Animal Control
- Urban redevelopment committees

Conservation Organizations

- Desert Tortoise Conservation Center/San Diego Zoo
- Tortoise Group
- Lahontan Audubon Society
- Red Rock Audubon Society
- Sierra Club

Other Key Partners

- Nevada Partners in Flight
- Great Basin Bird Observatory

Focal Areas

Carson Range
Carson Sink
Carson Valley
Las Vegas Valley
Pahrump Valley
Truckee Meadows
Virgin River Valley

Agricultural Lands

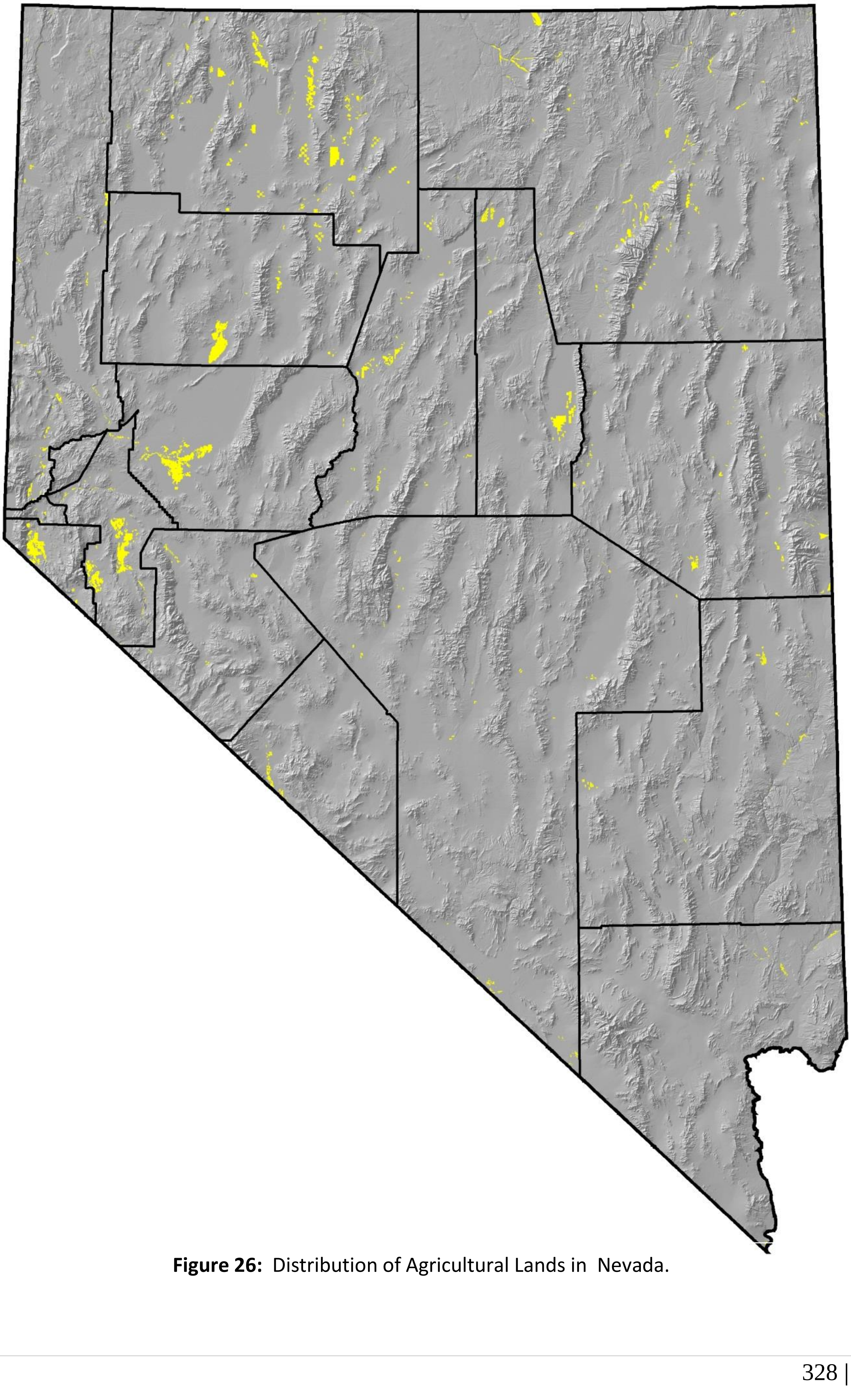


Figure 26: Distribution of Agricultural Lands in Nevada.

KEY HABITAT: AGRICULTURAL LANDS

Things to Know….

- Agricultural lands are found throughout Nevada at elevations from 600 to 7,500 feet and primarily in valley bottoms.
- High value habitat with flooded fields, unharvested hay fields, and fallowed fields. Key priority species include Greater Sage-grouse, Long-billed Curlew, and mule deer.
- Habitat threats include non-native invasive plants, shifts in land use, and timing conflicts between agricultural practices and key wildlife use periods (such as breeding).
- Climate change effects include a reduction in flood irrigated crop acres, unpredictable effects of runoff timing on harvested haymeadow, and a short-term increase in fallow field acreages could occur which can lead to conversion to invasive plant species
- The most available prescriptive action is to provide technical and financial assistance to private landowners for wildlife and habitat conservation.

Ecoregions

Southwest ReGAP 2005

Great Basin	181,262 hectares	447,900 acres
Columbia Plateau	36,738 hectares	90,781 acres
Mojave	4,258 hectares	10,523 acres
Total	222,258 hectares	549,204 acres

Ecological Systems*

SWReGAP Ecological Systems

N80 Agriculture

*No TNC biophysical settings were developed

Key Habitat Description

Agricultural crops are grown throughout Nevada, from 600 feet above sea level on the Fort Mohave Indian Reservation to over 7,500 feet elevation in the northern latitudes. Precipitation ranges from less than seven cm in the south to close to 38 cm at higher elevations in the north, while temperatures vary from -25 degrees F in the north to over 110 degrees F in the south. Most agricultural crops are grown in valley bottoms and on alluvial deposits. Hay, either alfalfa or grass, is the primary harvested crop (76% of Nevada's agricultural acreage), while wheat, barley, potatoes, onions, and garlic are also grown in much lesser amounts.

Value to Wildlife

Although Nevada is comprised mostly of publicly managed lands, the private lands tend to be in areas of high value to fish and wildlife species. These tend to be in valley bottoms in areas where water availability is above average. Therefore, agricultural lands host a variety of species, for at least some portion of the year, and provide a critical link for the survival of terrestrial species with varying habitat requirements on larger landscapes. Nevada's agricultural lands contribute to wildlife conservation in three basic conditions: flooded fields, unharvested hay, and fallow fields. Flooded fields are visited by a host of bird species that feed on the invertebrates displaced (beetles, etc.) or drowned (earthworms) by the flooding. Flooded fields are particularly important in the maintenance of breeding White-faced Ibis in valleys where agriculture and wetlands share prominence (e.g., Lahontan Valley, Churchill County). Unharvested hay, whether grass or alfalfa, is used by nesting birds such as Long-billed Curlew and in some places Greater Sage-Grouse. Meadows with tall, unharvested grass serve the nesting needs of Greater Sandhill Crane and Bobolink. Fallow fields in Nevada tend to attract ground squirrel colonies and if left undisturbed for long periods, generally experience a rodent population build-up that attracts a host of predatory raptors, including Prairie Falcon, Ferruginous Hawk, and Short-eared Owl. After summers of drought when total acreage tends not to be planted to full capacity, the concentrations of wintering raptors in agricultural zones such as Lovelock, Mason Valley, and Lahontan Valley can be impressive.

Species of Conservation Priority by Species Assemblage

FALLOW FIELDS-foraging, burrowing, small mammal populations that attract raptors

Prairie Falcon
Short-eared Owl
Ferruginous Hawk

FLOODED FIELDS – foraging

White-faced Ibis
American Avocet
Tricolored Blackbird

UNCUT MEADOW/HAY – nesting

Canvasback
Redhead
Northern Pintail
Greater Sandhill Crane
Long-billed Curlew
Wilson's Phalarope
Bobolink
Greater Sage-Grouse
Pahranagat Valley montane vole
mule Deer
Southwest blackhead snake

COTTONWOOD TREES – nesting structure, thermal cover, protection from predators

western red bat
Bald Eagle

CORNERS, MARGINS, FENCEROWS – perch sites for foraging bird species

Western Burrowing Owl

GENERALIST – perch sites, foraging
desert Horned Lizard
Common Nighthawk
little brown bat

Existing Environment

Land Uses

- Agriculture
- Livestock grazing
- Urban/suburban development
- Species harvest

Habitat Conditions

Active agricultural lands are relatively stable in the wildlife habitat values they provide when consistently managed although these values may vary cyclically with season and climatic variation. Trends toward more efficient methods of irrigation (drip, circular pivot) have proven less advantageous for wildlife, which are more compatible with traditional flood irrigation and grass hay operations.

Problems Facing the Species and Habitats

The key to maintaining agricultural lands for wildlife conservation in Nevada is in the timing of agricultural activities (irrigation, pesticide application, harvest) to avoid conflicts with key wildlife uses, mostly during the breeding season. Invasive weeds degrade both agricultural and wildlife habitat value. In addition to invasive weeds, threats to the long-term productivity of Nevada's agricultural lands may include increased pressure upon prime lands from residential and commercial development. When prime farm land converts to urban or suburban development, the wildlife values associated with agriculture are lost for generations. While a declining economy may result in lower pressures for conversion of agricultural lands due to urban/suburban development, it can also impact an agricultural producer's ability to consistently manage their lands from year to year. For example, alfalfa fields that are notably important to wildlife may be taken out of production because of the high costs of diesel fuel used to run irrigation pivots. Prolonged periods of decreased production will affect species that have traditionally depended upon these areas for nesting, foraging, or protective cover.

Predicted Effects of Climate Change

The following analysis is extracted from *"Economic Impacts of Climate Change on Nevada"* a review and assessment conducted by The Center for Integrative Environmental Research, Univ. Maryland (2008).

> *"Warmer temperatures, more rain and less snow in winter, and less rain in summer are predicted to impact agricultural productivity through a reduction in snow pack, earlier snowmelts, and increased runoff. Agriculture in general is predicted to become a riskier economic venture as seasons grow more unpredictable and competition for water resources with urban/suburban/commercial development increases."*

Based on those predictions, a reduction in acreage of flood-irrigated crops (e.g., alfalfa or haymeadow), unpredictable effects of runoff timing on harvested haymeadow, and a short-term increase in fallow field acreages could occur. Eventually, these plant communities within fallowed fields are likely to convert to non-native or noxious weed species unproductive for native wildlife communities.

Possible Responses of Wildlife to Climate Change

An overall reduced acreage of flooded alfalfa has probably already had a negative impact on the average size of the White-faced Ibis nesting population in Lahontan Valley (NDOW 2011). Average annual White-faced Ibis pair counts have decreased from ~2,800 (1986 to 1997) to ~1,900 (1998-2010) or roughly 32% since alfalfa acreage has been retired through water rights transfers and irrigation project operating criteria have been tightened. Other priority species likely to be negatively impacted by reduced foraging habitat include Long-billed Curlew and Wilson's Phalarope.

It is very difficult to predict specific effects of the climate change predictions above on grass haymeadow production, but transition to exotic forbs in early (haymeadow) riparian condition classes has already been discussed in the Intermountain Rivers and Streams chapter. To recount for specific agricultural land concerns, species dependent on productive, well-flooded haymeadow include Greater Sandhill Crane, Bobolink, Northern Pintail, Long-billed Curlew, Wilson's Phalarope, and mule deer. Species dependent on drier substrates but with significant build-up of residual vegetation (predominantly native grasses) include Short-eared Owl and Pahranagat Valley montane vole. Negative impacts of altered runoff patterns to the hydration of oxbows and other low floodplain depressions where cattails and bulrushes might grow could be expected to impact American Avocets, American Bitterns, Canvasbacks, Redheads, Tricolored Blackbirds, and river otters.

Initial increases in fallow acreage might benefit Ferruginous Hawks, Prairie Falcons, and Western Burrowing Owls. All three species would prey on ground squirrels and other rodents that would initially colonize these zones marginal to active cultivation.

Taking Prescriptive Action

Since agricultural lands were not included in our terrestrial habitats climate change analysis, no specific prescriptions were solicited from our expert restoration panels, but extensive interagency emphasis to provide wildlife conservation project assistance to private landowners has been deployed since 2001. Conservation programs under the Farm Bill such as the Wildlife Habitat Improvement Program (WHIP), Wetlands Reserve Program (WRP), Grasslands Reserve Program (GRP), and others administered by the Natural Resource Conservation Service (NRCS) have focused on projects and easements, such as protecting riparian floodplains by fencing out livestock from sensitive areas while allowing for alternative water delivery systems in pastures, restoring developed springs and spring brooks for the benefit of endemic fish and amphibians, and designing rotational grazing systems by fencing larger pastures into smaller ones. In 2010, the United States Department of Agriculture (USDA) launched a new effort to sustain working ranches and conserve Greater Sage-Grouse populations in the West known as the Sage-Grouse Initiative. Agricultural producers in Nevada can enroll in NRCS programs to simultaneously improve habitat for Sage-Grouse and improve sustainability and productivity of their native rangelands.

Other programs available to private landowners include the Partners for Fish and Wildlife Program (Partners Program) administered by USFWS and the Nevada Landowner Incentive Program (NLIP) administered by NDOW. The Partners Program has been working with private and tribal landowners who want to voluntarily improve fish, wildlife, and plant habitat on their lands. Similarly, the NLIP has worked with many of Nevada's citizen stewards through a federally funded competitive grant program. The Nevada Department of Agriculture Plant

Industry Division works to 'effectively coordinate resources and efforts toward proactive prevention, control, and management of invasive weed species in Nevada to benefit all land users in the state.'

Most of these programs involve a cost-share for project implementation. In addition to funding, all of these programs can provide technical assistance to landowners wishing to enhance habitat or modify management practices on their lands. Examples of projects include: control of non-native, noxious weeds; planting of native vegetation; installation of wildlife friendly fencing or exclosures to protect sensitive habitats; development of livestock grazing management plans to address specific needs of wildlife; purchase of conservation easements; implementation of prescribed burns to enhance or protect wildlife habitat; and removal of fish passage barriers (or installation to protect native fish populations from non-native fish species).

Priority Research Needs

- Demonstration of specific contributions of agricultural lands to wildlife conservation in Nevada
- Integration of private lands into landscape management design
- Integration of wildlife-based Best Management Practices with operational activities of agricultural enterprises
- Incentive strategies to facilitate pro-active wildlife conservation on agricultural lands in Nevada

Conservation Strategy

Goal: Healthy, secure wildlife communities in economically viable agricultural operations managed to meet wildlife needs for cover, food, and breeding while meeting the needs and objectives of landowners.

Objective: Improve 500 acres of riparian/meadow per year through 2022.

"500 acres" – computed as five projects per year averaging 100 acres in size per project

Action: Implement Sage-Grouse meadow restoration projects through landowner assistance programs available from NRCS, USFWS, or NDOW.

Action: Create incentives for landowner participation through the demonstration of increased economic value of restored meadows.

Objective: Achieve or maintain Greater Sage-Grouse brood use of recovered meadows by or through 2022.

"Achieve or maintain… brood use" - Specific contributions of habitat improvement to Sage-Grouse population improvement are hard to project because there is a disproportionate significant reliance on meadow habitats by brooding Sage-Grouse hens that is not readily geospatially computable; therefore, presence/absence of Sage-Grouse broods is the only practically measurable parameter available.

Objective: Provide habitat for up to 100 new breeding pairs of Long-billed Curlews (60 birds) on restored meadows through 2022.

"100 new breeding pairs" – computed at a rate of 15 breeding pairs per 250 acres (Hartman 2009), 500 acres of new restoration annually, and a 30% positive species response rate.

Action: Whenever possible, restore meadow habitats in contiguous blocks of 250 acres as opposed to smaller patches.

Objective: Provide habitat for 15 new breeding pairs of Short-eared Owls on restored meadows by 2022.

"15 new breeding pairs" – computed at a rate of one new potential territory per restoration project, 50 projects completed over the 10-year period, and a 30% positive species response.

Action: Whenever possible, restore meadow habitats in contiguous blocks of 125 acres or more in order to meet minimum patch requirements for Short-eared Owl nesting pairs (Holt 1992 *in* NatureServe 2011).

Action: Implement meadow management practices that encourage the buildup of residual vegetation through the nesting season to maximize rodent densities in Short-eared Owl nesting areas

Objective: Provide habitat for 15 new breeding pairs of Greater Sandhill Cranes on restored meadows through 2022.

"fifteen"15 new breeding pairs" – computed at a rate of one new potential territory per restoration project, 50 projects completed over the 10-year period, and a 30% positive species response.

Action: Implement meadow management practices that encourage the maintenance of uncut vegetation through the nesting and fledging season in order to maximize the escape cover value of meadow habitat to minimize incidence of predation on crane colts and increase colt survival.

Objective: Maintain a 10-year average of 3,000 nesting pairs of White-faced Ibis statewide through 2022.

"10-year average" – marsh-bird-nesting is cyclically tied to 10-year drought patterns; therefore, regularly occurring peaks and lows need to be factored in to the management target computation.

"3,000 nesting pairs" – 2,000 nesting pairs in Lahontan Valley averaged over a 10-year period plus 1,000 nesting pairs scattered over other suitable nesting sites around the state (Humboldt WMA, Humboldt River, Ruby NWR, etc.)

Action: Support efforts and assistance programs designed to preserve flood-irrigated croplands associated with key nesting colony sites (e.g. Lahontan Valley) from urban/suburban/commercial development and/or diversion of water rights to urban/commercial uses.

Action: Foster productive partnerships with farmers and ranchers through active acknowledgement of the value of flood-irrigation to wildlife and the importance of maintaining traditional farm practices on the Nevada landscape.

Objective: Maintain Ferruginous Hawk, Prairie Falcon, and Western Burrowing Owl populations at stable or increasing trend through 2022.

"stable or increasing trend" – as determined by NDOW raptor nesting surveys conducted regularly at intervals not to exceed five years.

Action: Support efforts and assistance programs designed to encourage and preserve fallow croplands as a standard element of productive agricultural landscapes in key raptor breeding and wintering sites (Lovelock Valley, Paradise Valley, Mason Valley, etc.)

Action: Coordinate educational efforts to encourage leaving fallow croplands with extension and NRCS programs that promote crop rotation as an important element of agricultural land health and productivity.

Action: Create incentives for farmers and ranchers to refrain from poisoning colonial rodents on fallow croplands and adjacent rangelands except where clear health risks have been identified.

Objective: Increase the current level of customer participation in private landowner wildlife conservation assistance programs significantly by 2022.

Action: Initiate a comprehensive species/habitat relationships analysis to define the key contributions of agricultural lands and activities to species conservation.

Action: Identify the role of private agricultural lands on landscapes under consideration for species conservation planning; develop coordinated management strategies involving stakeholders that recognize and account for the contribution of all properties to the successful achievement of conservation objectives for a particular landscape.

Action: Raise the value of wildlife to landowners by identifying wildlife conservation benefits that contribute positively to private landowner conservation assistance program evaluations, resulting in more successful competition for project funds.

Action: Maximize landowner participation in conservation programs by providing a full range of funding opportunities through the coordination of state, federal, and non-profit funding sources into an attractive and functional private lands assistance program that serves the needs of landowners while achieving tangible improvements in wildlife habitats.

Action: Encourage landowners and businesses to voluntarily invest in the improvement of natural resources to maintain the long-term ecological, economic, and social values provided by private lands.

Action: Develop and implement an outreach program featuring the importance of private agricultural lands to wildlife conservation in Nevada.

Action: In cooperation with landowners where appropriate, develop marketable aspects of wildlife management on their lands, including quality recreational experiences.

Action: Publicly recognize the contributions of individual landowners to wildlife conservation through awards and other appropriate forums.

Action: Coordinate activities with Nevada Division of Forestry where tree planting or removal is recognized as a benefit to wildlife species.

Action: Design adaptive management strategies with wildlife monitoring elements and secure funding to measure project success by wildlife response toward the achievement of mutually-crafted objectives.

Action: Share resources and guides with Nevada landowners describing the use of proven conservation practices for improving wildlife habitat while enhancing the agricultural landscape. Practices include wildlife plantings, riparian habitat management, wildlife watering facilities, suggested grazing and haying management practices; discuss materials acquisition, funding, and technical consultation opportunities; describe rotating land uses, resting pastures, adjusting grazing treatment timing and duration, maintenance of mixed habitat types, edge-effect concepts, etc.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Private	79.4
Bureau of Reclamation	10.7
Bureau of Land Management	4.9
Tribal	3.2
Other	1.8

Existing partnerships, plans, and programs

Federal & State Agencies

- USDA Natural Resource Conservation Service and Conservation Districts
- Bureau of Land Management
- Bureau of Reclamation
- U.S. Forest Service
- U.S. Fish & Wildlife Service
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Department of Agriculture

Conservation Organizations

- National Audubon Society/Lahontan Audubon Society/Red Rock Audubon Society
- The Nature Conservancy
- University of Nevada Cooperative Extension Service

Other Key Partners

- Great Basin Bird Observatory

Focal Areas

Amargosa Desert
Big Smoky Valley - North
Carson Sink
Carson Valley
Fish Lake Valley
Marys River Drainage
Moapa Valley - East
Pahrump Valley
Ruby Valley
Salmon Falls Creek Area
Snake Valley
Spring Valley
Steptoe Valley
Truckee Meadows
Upper Reese River Valley
Virgin River Valley
White River Valley

Barren Landscapes

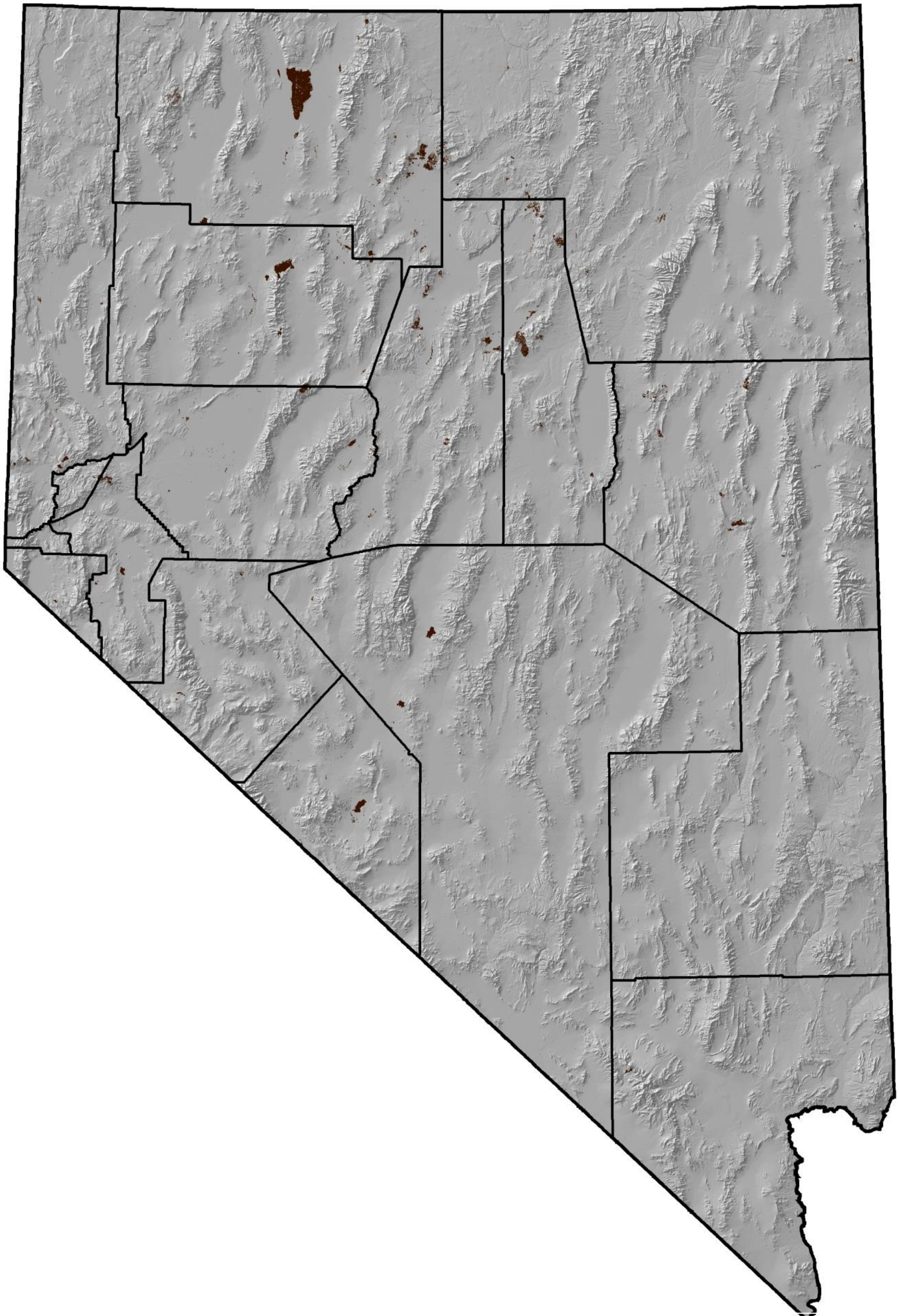


Figure 27: Distribution of Barren Landscapes in Nevada.

KEY HABITAT: BARREN LANDSCAPES

Things to Know….

- Barren landscapes are naturally "barren" or have become barren as a result of activity, such as mining or fire.
- These sites typically are avoided by wildlife since there is little cover and forage value, but may be inhabited by chuckwalla, western banded geckos, and other reptiles in areas of close juxtaposition with food-producing habitats.
- Habitat threats include non-native invasive plants, erosion, and recreation (OHV).
- Annual grasses will experience a range expansion into barren lands as a result of climate change.

Ecoregions

Southwest ReGAP 2005

Great Basin	68,904 hectares	170,262 acres
Columbia Plateau	38,971 hectares	92,297 acres
Sierra Nevada	352 hectares	869 acres
Mojave	721 hectares	1,783 acres
Total	108,948 hectares	269,211 acres

Ecological Systems*

SWReGAP Ecological Systems

N31 Barren Lands, Non-Specific
D03 Recently Mined or Quarried
D02 Recently Burned

*No TNC biophysical settings were developed

Key Habitat Description

This ecological system includes lands that are either barren in their natural state or have been subject to landscape altering forces such as mining or fire and are barren as a result of these actions. Areas classified as barren lands include areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earthen material. Generally, vegetation accounts for less than 15% of total ground cover in these areas. Recently mined or quarried areas are those areas two hectares or more in size, where open pit mining or quarries were visible in satellite imagery acquired for SWReGAP between 1999 and 2001. Similarly, areas visible in the 1999-2001 satellite imagery for SWReGAP that had burned in the recent past and were clearly evident in the imagery were classified as recently burned.

Value to Wildlife

For disturbed sites, much of the value of these sites lies in their potential for restoration to meet wildlife habitat needs. As areas essentially denuded of cover that offer little or no food values, these sites tend to be avoided by wildlife, though exceptions occur. Some reptiles will utilize these areas, though probably making only brief incursions before returning to more favorable habitat types. Bighorn sheep will also utilize these areas, primarily during daily or seasonal movements. Finally, where ledges and crevices occur in open pit mine walls, bats and some species of cliff-nesting birds will utilize such sites for nesting or roosting.

This ecological system does contain natural elements. In particular, the talus and slide elements can be used for cover and foraging areas for a variety of wildlife, and they are critical to American pika. Pika require a secure environment where they can readily escape from predators, cache the hay supplies that allow them to endure long winters, and most important offer a refuge from warm temperatures which this species is physiologically incapable of surviving.

Key Elements of Barren Lands Habitat Important to Wildlife

HIGH WALLS – nesting or roosting in ledges and crevices

Prairie Falcon
Peregrine Falcon
Ferruginous Hawk
Golden Eagle
Great Basin collared lizard
bighorn sheep
chuckwalla

ROCKY SLOPES AND TALUS– foraging, protection from predators, thermal cover, food storage

American pika
long-eared myotis
spotted bat

GENERALIST – using a variety of elements in multiple habitats

western banded gecko
long-nosed leopard lizard
greater short-horned lizard
desert horned lizard

BARREN FLATS/BURNED – movement corridors, nesting substrate (ground nesters)

Common Nighthawk
Western Burrowing Owl

Existing Environment

Land Uses

- Motorized recreation
- Minerals/oil/gas extraction
- Utility rights-of-way
- Military mission
- Road development
- Improper Fire Restoration Policy
- Species Harvest

Habitat Conditions

Sites that have been modified from their original form and largely stripped of the natural vegetation communities that once characterized them are considered to be in poor condition. Though not entirely devoid of wildlife values, the sites certainly offer less to wildlife than when they were in their natural state. In sites that have been altered by ground-moving activities, little to no soil remains to reestablish vegetation, however, mine reclamation plans typically call for the replacement of soil and reseeding of sites. In burned areas, the native seed bank may be absent because of the heat of the burn or because the native vegetation at the site had long-ago been supplanted by invasive species. Mid-to-low elevation burned sites are at considerable risk of being invaded by cheatgrass, requiring difficult and expensive management intervention to reverse or reclaim. Burned lands converted to cheatgrass are of reduced value to wildlife and livestock, and reduce agency options when managing these landscapes under a multiple use mandate.

Sites which are barren by nature have relatively fewer habitat values to offer wildlife. If left undisturbed, these sites can be considered to be in good condition, at least within the context of their inherent potential. Some scree and talus slopes in Nevada have been selected as a ready source of rock material and have been or are being mined.

Problems Facing the Species and Habitats

Disturbed areas, particularly at mid-to-low elevations, can be conduits for weed invasion. These sites may also be susceptible to erosion, either facilitated by wind and rain or by OHV use in the disturbed area. The forces that create barren landscapes are by their nature agents of habitat alteration and destruction, and generally without active restoration can result in landscape conversion. Typically, without some form of active restoration effort, these sites continue to decline, and so problems for some of these landscapes include a lack of adequate response, including, in some cases, “no action” after a fire. Mineral, oil, or gas extraction practices can lead to habitat destruction, wildlife displacement, toxic waste ponds, and additional habitat loss through development of infrastructure such as roads and site development. These impacts are typically mitigated through site reclamation plans, but for sites where no such plans were adopted these changes can lead to permanent habitat loss.

Predicted Climate Change Effects

Specific climate change analysis was not conducted as part of the terrestrial habitat project administered by TNC, but barren ground was identified as one of the type conversions for the lower Mojave shrub types (salt desert scrub, creosote bush/bursage, and thermic blackbrush) as the effects of fire regime alteration by annual grass/forb invasion played themselves out to ultimate effect. Should higher temperatures be coupled with higher annual rainfall as much as 20% in areas such as the Tonopah region as some models predict (Univ. Maryland 2008 – see Agricultural Lands chapter*)*, reclamation efforts on disturbed lands such as mines and tailings might even benefit over the short term, but for the most part, an increase in barren lands sparsely vegetated by annual grasses and forbs is not a scenario generally anticipated in positive terms with regard to wildlife habitat value.

Vertical hardrock surfaces (cliffs, high walls, stacks, etc.) are for the most part inured to climate change themselves, but the conversion of the attendant vegetation of these surfaces (such as it may be) from native perennial to exotic annual would generally be viewed as a loss in wildlife habitat value. Softer vertical surfaces (e.g. high-wall Lahontan beach deposits) would be subjected to greater erosion events under climate change scenarios of more winter rainfall, earlier and more intensive runoff.

Possible Wildlife Responses to Climate Change

In general, an increase in barren lands under these classification types would not be considered beneficial to wildlife – not even the priority species identified in this chapter. The impacts of the incremental loss of the Mojave shrub layer have already been discussed in the Mojave Shrub chapter and again in the Dunes and Badlands chapter. Wildlife use of expanding acreages of barren lands would be restricted to the edges within reasonable reach of shade and escape cover except in the odd cases where available water might be restricted to the interior of barren lands or stress from harassment or predation might drive herds or individuals out into these lands for relief.

Priority Research Needs

- Vegetation restoration techniques – seed mixes, timing of planting, seed sources, local plant adaptations
- Detailed wildlife/habitat relationships information that can be applied to specific restoration site design for the Species of Conservation Priority
- Cost-effective restoration protocols for stopping the advance of cheatgrass

Conservation Strategy

Goal: Natural or restored landscapes capable of supplementing the life history needs of wildlife adapted to disturbed habitats, habitats in transition, or newly created landscapes, habitats, or opportunities.

Objective: As operations cease or shift away from inactive disturbed lands and tailings, reclaim mine sites to function as habitat for wildlife, particularly Species of Conservation Priority through 2022.

Action: Develop a working relationship among WAP partners and working mines, facilitated by the Nevada Mining Association, to collaboratively develop techniques for improving reclaimed site conditions, incorporating the needs of priority species.

Objective: Where "windows of effectiveness" exist after wildfire, take positive action to revegetate burned sites in habitats susceptible to cheatgrass invasion within one year of burning through 2022.

Action: Continue to develop and improve restoration techniques using native seed mixes and plant stocks.

Action: Prioritize affected landscapes to identify those sites where reseeding should be a priority.

Action: Treat burned sites in an expedient manner, timing seeding to best take advantage of naturally available moisture.

Action: Integrate WAP strategies for sagebrush and invasive grasslands and forblands into this strategy, particularly elements pertaining to fire management and site restoration.

Partnerships

Land Management/Ownership

Land Owner/Manager	Percent
Bureau of Land Management	75.3
Private	22.4
Other	2.3

Existing partnerships, plans, and programs

Federal & State Agencies
- Bureau of Land Management
- U.S. Forest Service
- Natural Resources Conservation Service/Nevada Conservation Districts
- Nevada Division of Forestry
- Nevada Department of Wildlife

Other Key Partners
- Counties
- University of Nevada (UNR, UNLV)
- Sierra Club
- Mining Industry/Nevada Mining Association
- Eastern Nevada Landscape Coalition
- Eastern Nevada Landscape Restoration Program
- Great Basin Restoration Initiative

Focal Areas

Big Smoky Valley - North
Black Rock Range
Buffalo Hills
Butte Valley - South
Carson Sink
Cherry Creek Range
Clan Alpine Mountains
Fish Lake Valley
Huntington Valley
Independence Mountains
Madelin Mesa
Mud Spring drainage
Pahrump Valley
Roberts Creek Mountains
Ruby Mountains
Ruby Valley
Santa Rosa Range
Sheldon NWR
Shoshone Range
Spring Mountains
Toiyabe Range
Toquima Range
Tuscarora Mountains
White River Valley

KEY PARTNERSHIPS AND IMPLEMENTATION MECHANISMS

Once evaluated and prioritized, project implementation, particularly habitat manipulation, must be programmed into existing land use planning structures, whether federal, state, tribal, or private. While there are as many planning structures out there as there are land management partners, the Nevada WAP Development Team has identified several major planning processes, or implementation mechanisms that are particularly important to the success of the WAP. It is impossible to describe all of the potential partnerships and implementation mechanisms that might be activated during the life of the WAP, so the Team hopes that by describing these key implementation mechanisms in considerable detail, readers can develop a sense of the general preferred approach to integrating WAP objectives and strategies into appropriate land use planning structures. Please keep in mind that these integration “models” are only being proposed as the “preferred method” from the viewpoint of the WAP Development Team, and do not necessarily represent any endorsement or official sanction from any of the identified partners. The details of these collaborations may need to be adjusted in order to achieve agreement among the entities involved. Those dialogues have already started with most of the featured entities, and consensus will be pursued over the earliest months of implementation past ratification of the WAP.

National Scale Efforts

National Fish, Wildlife and Plants Climate Adaptation Strategy

In 2009, Congress urged the White House Council on Environmental Quality and the Department of Interior to develop a national climate adaptation strategy to assist fish, wildlife in becoming more resilient and adapting to the impact of climate change.

The recently developed “National Fish, Wildlife and Plants Climate Adaptation Strategy” is a comprehensive, multi-partner blueprint for addressing the threat of climate change across the country. It provides natural resource professionals and other decision makers with a basis for sensible actions that can be taken now in spite of the uncertainty about precise impacts of climate change on natural resources. The strategy is structured around five ecosystem sections: inland waters, the marine environment, forests, and grasslands/shrublands/deserts/tundra. Each ecosystem section identifies climate impacts and key goals, strategies and actions for managing species and natural resources in a changing climate. In addition the strategy includes indicators of success to help track progress and also national level strategies for cross-cutting issues such as the role of agriculture, transportation and invasive species on the resiliency of fish, wildlife and plants.

The U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration (NOAA) and the New York Division of Fish Wildlife and Marine Resources (representing state fish and wildlife agencies more broadly) co-lead the development of the strategy. The Association of Fish and Wildlife Agencies also provided support for the strategy. The strategy was developed with input from an intergovernmental Steering Committee with federal, state, and tribal governments participating along with input from non-governmental organizations, industry, and private landowners.

Regional Landscape Scale Efforts

Southwest Climate Science Center

In 2009, Secretary Salazar called for the establishment of a network of eight regional Climate Science Centers (CSCs) to provide scientific information needed by natural and cultural resource managers as they address the impacts of climate change. The order also called for the establishment of Landscape Conservation Cooperatives (LCCs) that bring together resource managers to plan for landscape scale conservation. LCCs offer another opportunity for involvement in climate adaptation planning.

In 2010, DOI's Secretary announced the establishment of the Southwest Climate Science Center (SWCSC) to be one of eight Regional Climate Science Centers in a national network to help foster the research needed to understand regional implications of climate variability. Nevada falls within the administrative jurisdiction of the SWCSC. The SWCSC is a federal-research institution partnership. With a director and small federal research staff, the SWCSC will integrate the expertise of a consortium of six research institution hosts and will be based in Tucson, Arizona (See below for list of institutions.) The specific research, monitoring, and data management activities of the SWCSC will be shaped by the needs of natural and cultural resource managers in the region. Neighboring regional CSCs are based at Fort Collins, Colorado (North Central CSC), Lubbock, Texas (South Central CSC), and Corvallis, Oregon (Northwest CSC). Each of these CSCs has a consortium of research institutions.

The overall goals of the network of CSCs are to:

- assess the vulnerability of natural and cultural resources to climate change;
- predict changes in natural and cultural resources in response to climate change;
- link the output from climate models (such as projected temperature and precipitation changes) with models that predict responses to climate variation;
- standardize approaches to monitoring and link existing monitoring efforts to models of climate variability and resource response; and
- develop data management policies and practices to ensure that data generated at NCCWSC and the CSCs are shared and interoperable with other datasets.

Within this broad mandate, each CSC will define an overall regional Science Agenda based on input from resource managers. This process will be overseen by an executive-level Stakeholder Advisory Committee (SAC) with representation from tribes, states, federal agencies, and LCCs in the region. SAC members will advise the SWCSC about its Science Agenda and research activities. Both NDOW and DCNR have membership on the SAC. The SWCSC research program will be undertaken by federal researchers and a consortium of research institution scientists supported by the SWCSC.

The SAC will help develop guidance for high level science planning and priority climate science needs related to land, water, and cultural resources management in the Southwest (executive and senior level leaders who create a long-term strategy for addressing current and future impacts of climate variability on our region's lands, water, fish, wildlife, and cultural heritage. The SWCSC will provide assistance to natural and cultural resource managers who are faced with planning and implementing actions for mitigating and adapting to climate change.

SWCSC Host Institutions:

- University of Arizona, Tucson
- University of Colorado, Boulder
- University California, Davis

- University of California Los Angeles,
- Desert Research Institute (University of Nevada System, Reno)
- Scripps Institution of Oceanography, University of California, San Diego.

In addition to the six host institutions, the SWCSC also includes the following as partners:

- Arizona State University, Tempe
- Northern Arizona University, Flagstaff
- University of California, Merced
- University of Nevada, Las Vegas
- NASA Ames Research Center
- U.S. Institute for Environmental Conflict Resolution, Tucson

Western Governor's Association: Crucial Habitat Assessment Tool (CHAT)

With the adoption of its *Wildlife Corridors Initiative Report* in June 2008, the Western Governor's Association (WGA) created the Western Governors' Wildlife Council - consisting of designees from 17 WGA member states – and tasked its members to develop policies and tools to identify and conserve crucial wildlife habitat and corridors across the region. The Wildlife Council is working to make information on important fish and wildlife habitat compatible across the West and available to the public in 2013 for use in informing land use decisions.

Economic progress across the West depends on the successful completion of energy, transportation, land use and other large-scale development projects that must incorporate potential wildlife impacts into their planning. To help ensure both wildlife and local economies remain viable, WGA began examining how state wildlife agencies could be more innovative in providing wildlife species and habitat information to their various "customers" – including Federal agencies, other state agencies, local and tribal governments, conservation advocates, business and industry groups, private landowners, outdoors enthusiasts and even foreign countries.

A collaborative effort among 17 states, the Western Wildlife Crucial Habitat Assessment Tool (CHAT) aims to bring greater certainty and predictability to planning efforts by establishing a common starting point for discussing the intersection of development and wildlife. The CHAT will be an easily accessible online system of maps displaying crucial wildlife habitat and corridors across the West. While not intended for project-level approval , CHAT will lead to fewer conflicts and surprises while ensuring wildlife values are better incorporated into land use decision-making as well as large-scale conservation projects.

In addition to helping states establish their individual CHATs, the Wildlife Council is creating a "regional CHAT" to provide an informed and continually updated picture of crucial wildlife habitat across the West. The state and regional CHATs will be non-regulatory but give project planners and the general public access to credible scientific data at the broad scale for use in project assessment, siting and planning – including on large-scale development projects spanning multiple jurisdictions.

In June 2010, Governors across the West committed to having their states complete regionally compatible CHATs and make them public within three years. From now through October 2012, the Western Governors' Wildlife Council will develop options for constructing and maintaining the regional CHAT, while their state agencies will continue working together to compile important data sets, apply crucial habitat definitions and build and improve upon their individual state CHATs. From November 2012 to December 2013, the focus of activity will be to knit each state's crucial habitat layers together in the regional CHAT.

During 2010-2011, Nevada partnered with California, Arizona and Utah on a four state pilot project funded by the Department of Energy through the Western Governors' Association. This effort will provide proactive decision support GIS tools among the western states in the form of identifying crucial habitat for all wildlife species for use in land management environmental and planning efforts. NDOW views the development of Nevada's CHAT as essential for us to improve our understanding of crucial wildlife habitat and corridor information and to provide that information to our stakeholders.

The strategy for land-managing agency conservation project planning has changed in the last few years from one of a small (thousands of acres or smaller), packaged, single year, single treatment approach to a large (hundreds of thousands of acres), multi-year, multi-component effort. The landscape level effort is usually addressed in a single (usually EIS-level) document and involves a coordinated group of agencies or organizations in the effort.
The landscape approach is better integrated with neighboring activity and addresses a wider range of issues than the smaller-scale projects have addressed. This has been particularly important when looking at the cumulative impacts to landscape species such as sage grouse and mule deer. The projects incorporate both pre and post implementation monitoring and are more comprehensive in their accommodations of other land uses and activities.

The landscape approach examines such larger areas to more fully recognize natural resource conditions and trends, natural and human influences, and opportunities for resource conservation, restoration, and development. The approach seeks to identify important ecological values and patterns of environmental change (such as climate change) that may not be evident when managing smaller, local land areas.

The broader perspective provided through a landscape approach will help focus and integrate local management efforts. A landscape approach also provides an important foundation for developing coordinated management strategies with partner agencies, stakeholders, and American Indian Tribes.
There is a growing group of landscape-level efforts in progress in Nevada, which will be briefly discussed below. Most of these efforts have websites that provide much greater detail for those interested in learning more about them and how they relate to NDOW and the Wildlife Action Plan.

Bureau of Land Management Rapid Ecological Assessments (REAs)

Climate change and other widespread environmental influences are affecting western landscapes managed, in part, by the Bureau of Land Management (BLM). In response, the BLM in 2010 launched seven Rapid Ecoregional Assessments (REAs) to improve the understanding of the existing condition of these landscapes, and how conditions may be altered by ongoing environmental changes and land use demands. Three of these are in Nevada – the Northern Great Basin (NBR), the Central Great Basin (CBR) and the Mojave Basin and Range (MBR), collectively called Nevada's REAs (NV REAs). REAs are called "rapid" assessments because they synthesize existing information, rather than conduct research or collect new data, and are generally completed within 18 months.

NV REAs began as a list of management questions from an ecoregion's resource managers. The questions identified management issues or concerns that could not be resolved by individual offices alone and have regional importance. These REAs examine ecological values, conditions, and trends within ecoregions, which are large, connected areas that have similar environmental characteristics. Ecoregions span administrative boundaries and typically encompass areas much larger than those managed by individual BLM field offices. Assessments of these larger areas provide land managers additional information and tools to use in subsequent resource planning and decision-making.

NV REAs look across the NBR, CBR, and MRB ecoregions to more fully understand ecological conditions and trends; natural and human influences; and opportunities for resource conservation, restoration, and development. They seek to identify important resource values and patterns of environmental change that may not be evident when managing smaller, local land areas. The REAs provide regional information that will inform and benefit local management efforts.

REAs describe and map conservation elements (species), which are of high ecological value. REAs look across all lands in an ecoregion to identify regionally important habitats for fish, wildlife, and species of concern. REAs then gauge the potential of these habitats to be affected by four overarching environmental change agents: climate change, wildfires, invasive species, and development (both energy development and urban growth). The selection of conservation elements and change agents is done in a collaborative process with NDOW, FWS, FS, and others. REAs also help identify areas that do not provide essential habitat; that are not ecologically intact or readily restorable; and where development activities may be directed to minimize impacts to important ecosystem values.

In addition, REAs establish baseline ecological data to gauge the effect and effectiveness of future management actions. In this way, REAs provide a foundation for an adaptive management approach that enables implementation strategies to adjust to new information and changing conditions.

It is important to note that these REAs do not allocate resource uses or make management decisions. They provide science-based information and tools for land managers and stakeholders to consider in subsequent resource planning and decision-making processes.

The BLM will use the REAs to inform resource management at the ecoregional and local levels. At the ecoregional level, along with input from stakeholders, partner agencies, and Tribes, the REAs will aid in developing broad-level management strategies for an ecoregion's public lands. This ecoregional direction will identify priority areas for conservation and development, including focal areas for conserving wildlife habitats and migration corridors, and focal areas for potential energy development and urban growth. Ecoregional direction will also provide a blueprint for coordinating and implementing these priorities through the BLM's state and field offices.

At the local level, the REAs will enhance the quality of land-use planning and environmental analysis conducted by BLM field offices. The information, maps, and tools provided by the REAs will strengthen analyses of the potential and cumulative effects of climate change and other environmental disturbances on important ecological values.

In addition, the REAs present an opportunity for all land managers within an ecoregion to share information and discuss resource management conditions and needs. These REAs will provide a science-based information platform for formulating coordinated, multi-agency strategies that can respond effectively to climate change, wildfire, and other environmental challenges that transcend local administrative boundaries.

The BLM plans to use the information from the Rapid Ecoregional Assessments (REAs), along with input from partner agencies, stakeholders, and American Indian Tribes, to develop landscape-level management strategies for BLM-managed lands. These landscape-level management strategies are called ecoregional direction.

The purpose of ecoregional direction is to help focus and coordinate the BLM's local management efforts so they work together to achieve vital resource management goals that span field office jurisdictions. To accomplish this, ecoregional direction will identify focal areas on BLM-managed lands for conservation and development, including focal areas for conserving wildlife habitats and migration corridors, and focal areas for potential energy development and urban growth. Ecoregional direction will also provide a blueprint for implementing this integrated resource conservation and development strategy through the BLM's national and field-level organization.

Landscape Conservation Cooperatives

In 2010, the Department of Interior developed a plan for a coordinated, science-based response to climate change impacts on land, water and wildlife resources. The Landscape Conservation Cooperatives (LCCs) were developed as the applied science branch of this strategy. Each of the 22 LCCs functions in a specific geographic area and form a national network that serves as a management-science partnership. Nevada encompasses portions of both the Great Basin and the Desert LCCs. NDOW has a representative sitting on the Steering Committees of both the Desert and the Great Basin LCCs ensuring Nevada's issues are addressed and also to ascertain the integration of state planning processes such as Nevada's Wildlife Action Plan into the LCCs.

Desert LCC

The Desert LCC encompasses portions of five U.S states and 10 states in northern Mexico, and includes the Mojave, Sonoran, and Chihuahuan deserts. The LCC also includes several large river systems including the lower Colorado, Gila, Rio Grande, San Pedro, and Verde Rivers. The Colorado River Basin is one of the most critical sources of water in the West. The Bureau of Reclamation and the USFWS have partnered to administer the Desert LCC. The Desert LCC will be a self-directed partnership managed by a steering committee comprised of government agencies (federal, state, Mexican, tribal and local) as well as non-governmental organizations, universities and other stakeholders.

The primary goals of the Desert LCC are to:

- Develop a shared conservation vision for the Desert LCC;
- Determine threats to priority resource, habitats, species and science needs; and to
- Identify existing resource and science partnerships relevant to the LCC.

The Desert LCC will develop science capacity to support resolving various management issues identified by the Steering committees including:

- The effect of long-term drought on the composition, abundance and distribution of species;
- The effect of reduced water available on vegetation, wildlife and human populations;
- The effects of warming on insect outbreaks and increasing tree mortality; and others.

Great Basin LCC

The Great Basin LCC will help link and integrate science information providers with resource managers and science users; bring additional DOI resources to bear on landscape-scale conservation issues and opportunities; and help to apply science and facilitate coordination on a wide range of efforts to respond to climate change, invasive species, wildfires, human development and other stressors across the Great Basin. Specific objectives and shared priorities will be determined by the partnership itself. The LCC is not intended to replace existing organizations already accomplishing conservation work in the Great Basin. The aim is to facilitate, enhance and inform that work.

The mission of the Great Basin LCC is to enhance the understanding of the effects of changing climate and other natural and human impacts across the region and promotes the coordination of science-based actions to enable human and natural communities to respond and adapt to those conditions.

The primary goals of the Great Basin LCC are to:

- Provide leadership and a framework linking science and management to address shared ecological, climate, and social and economic issues across the basin.
- Focus science and management actions to sustain natural resources in the context of changing environmental conditions.
- Enhance collaboration to integrate science and management among Great Basin LCC partners particularly as related to climate change and other landscape-scale change agents.
- Promote communication and education.

A Multi-Layered Conservation Example: Greater Sage-Grouse

Current Status of Sage Grouse Planning in Nevada

There are two huge planning efforts designed to prevent a full listing of the Greater Sage-Grouse in process in the State of Nevada. The last U.S. Fish and Wildlife Service (USFWS) listing evaluation under the regulations of the Endangered Species Act (March 2010) assigned the Greater Sage-Grouse a Candidate status with a listing priority of 8 and the Bi-State population a listing priority of 3. The listings were determined warranted but precluded due to other species under consideration having a higher priority. This was a wake-up call for the agencies involved and a time to take action to prevent a full listing. As a result, the State and federal resource management agencies where Sage grouse habitat is present, have been working feverously to put into place scientifically defensible data and management directions to provide sufficient protection for Sage grouse and its habitat in order to prevent a full listing of the species.

In 2004, under former Governor Guinn, a series of local working groups developed plans to provide a comprehensive strategy for conservation measures to provide protection and minimize habitat loss in Nevada. Although some actions recommended by those plans have taken place, sufficient funding has not (until recently) come available to provide a broad series of projects or institute land management practices that were sufficient to reverse the bird's decline. Lead by the Nevada Department of Wildlife (NDOW), the Nevada Governor's group has remained active and meets regularly to address issues in relation to conservation actions.
Bi- State Population

There have been great efforts already put into place by both agencies and private landowners to provide for habitat restoration and protection for the Bi-State Population. It has been identified that although these efforts are beneficial, there has been a lack of coordination among these efforts.

In 2004, the Bi-State local working group produced a Conservation Plan which identified conservation strategies to be employed to restore degraded habitat and provide protection to the remaining population. Since production of the plan, many projects have been implemented but the information on them is not centralized and efforts have not proven to be sufficiently coordinated.

More recently, the local working group has been meeting and sharing information. There has been a joint interagency technical group meeting to discuss the issues of the population and a move towards a more organized approach of management. The Natural Resource Conservation Service (NRCS) and NDOW have a shared position, with specific responsibilities to the Bi-State population and the Nevada Partners for Conservation and Development have initiated joint agency-funded habitat restoration projects and a massive organizational effort is in progress.

A Bi-state Interagency Executive Oversight Committee (Bi-state EOC) has been established to provide strategic direction and ensuring funding and other resources are committed for three interagency working groups (technical, strategy and policy) to develop and implement an action plan to respond to the population threats identified by the USFWS in their 2010 listing evaluation. The first action by the Technical Working Group will be to meet and work with the local working group to develop the Action Plan by January 1, 2012. The next listing evaluation of the Bi-State population is scheduled to occur by October 2013. By that time, demonstrable successes and management direction will be in place to hopefully offset the need for a full listing.
Greater Sage Grouse Populations – Federal Land Management Agencies Efforts

Similar to the Bi-state population, a great deal of work has already been completed on projects designed to restore Sage-Grouse habitat in Nevada. The Governor's Sage Grouse Conservation Team (representing State and federal agencies and a wide range of public and private interests and public land users) have been meeting regularly and last year produced the "Nevada Energy and Infrastructure Development Standards To Conserve Greater Sage-Grouse Populations and Their Habitats" publication.

Results from the USFWS 2010 listing evaluation have pointed to the need to provide greater policy direction and regulatory controls to ensure protection of Sage-Grouse habitat. Towards that end, the Bureau of Land Management (BLM) has prepared a nationwide Instructional Memorandum (IM) to provide interim guidance on lands that they manage until such time that policy direction and conservation measure can be inserted into their Resource Management Plans (RMP's).

The BLM has already established a National Technical Team that is developing a set of conservation measures, while at the same time, state wildlife management agencies are constructing habitat classification mapping to prioritize habitat to aid in the implementation of conservation measures. A much greater organizational effort by the BLM is under way to fulfill the National Environmental Policy Act requirements to incorporate these measures into the RMP's in those areas where Sage-Grouse habitat is present. National, Regional and Sub-Regional interagency teams have been formed. Nevada and California comprise one sub-regional team who will manage the production of an Environmental Impact Statement (EIS) to address adding the conservation measures to the RMPs in the two states. A total of four EISs are planned for the western-most states.

Outreach has started and is ongoing. To date, the BLM has discussed their plans with: the Nevada Cattlemen's Association, The Grazing Advisory Board, and the Nevada Mining Association and has had discussions with specific Nevada agencies including the Energy Office and Department of Conservation of Natural Resources. A presentation was also made to the Governor's Sage Grouse Conservation Team that represents many interests in the state. Public Scoping for the EIS were scheduled in 2012 with meetings in Elko, Reno, Winnemucca, and Susanville. Land Use Plans and a Record of Decision are planned for completion in September 2014.

The US Forest Service controls approximately 8% of the Greater Sage-Grouse habitat across the west and more than 45% of the Bi-state. Currently, the USFS is formulating plans to evaluate and modify their Forest Plans to address threats to the Sage-Grouse. More information will be forthcoming as these plans are unveiled.

In March 2010, NRCS announced a $21 million Sage-Grouse Initiative (SGI) to restore and conserve declining populations of Sage-Grouse and their habitat using two popular USDA conservation programs — the Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentive Program (WHIP). The SGI will give participating landowners the opportunity to help conserve Sage-Grouse and contribute to efforts that may make listing under the Endangered Species Act (ESA) unnecessary. To promote conservation of both the greater and the Gunnison Sage-Grouse, NRCS Chief Dave White and Acting Director of FWS Rowan Gould signed a Partnership Agreement on March 12, 2010, to aid these species while helping sustain working ranches and farms in the West. The Partnership Agreement initiated development of a Conference Report for Sage-Grouse that was completed on July 30, 2010. To date NRCS has committed approximately $120 million to this effort

Through the NRCS SGI, significant financial and technical assistance is available to private landowners to implement voluntary, proactive conservation actions, both on their own land and leased Federal and State lands. The goal of the SGI is to increase Sage-Grouse populations by improving habitat while sustaining working farms and ranches. The Initiative is focused strategically on core areas with significant populations of Gunnison and greater-sage grouse and habitat in 11 western States – Wyoming, Montana, Idaho, Colorado, Utah, Nevada, California, Washington, Oregon, South Dakota, and North Dakota.

NRCS and FWS used the “conferencing” provisions under Section 7 of the ESA to assess the potential benefits and adverse effects of specific NRCS conservation practices to be implemented and maintained by landowners under SGI. The conference report analyzes the expected cumulative effects of the implementation on the species through careful review of specific NRCS conservation practices and how they will be implemented to remove or reduce the known threats to these sagebrush dependent species. Should either Sage-Grouse species be listed in the future, the report can be used as the basis for preparing a Biological Opinion under Section 7 of the ESA that would include “incidental take.”

During development of the conference report, USFWS worked closely with NRCS to determine the effects of 40 individual conservation practices, both those that will be beneficial and those that could potentially adversely affect the birds and their habitat. Conservation measures were developed to avoid, ameliorate, or minimize the identified adverse effects that could result from implementation of the practices prescribed in landowners' conservation plans. Each State NRCS office is collaborating with State Wildlife Agencies to develop blanket requirements to limit physical disturbance of Sage-Grouse.

Implications for other Sagebrush Species

There are more than 25 projects either in progress or far along on the planning designed to restore or enhance sage grouse habitat in Nevada. The majority of these efforts are occurring on Public Lands. The cost is in the millions of dollars and tens of thousands of acres are involved. While this is a considerable benefit to sage grouse, many other sagebrush species will benefit from these actions. It is expected that for the majority of projects weedy species will be replaced by native vegetation, pinyon-juniper encroachment will be held in check or reduced and the fire cycle will be lengthened by the construction of green strips and other fire breaks which will also act as a barrier to halt the spread of large catastrophic fires.

Another large benefit of the anticipated Sage Grouse conservation measures will be the identification and protection of high value habitat. It is anticipated that large tracts of land critical to sage grouse conservation will be protected from development and other forms of disturbance. The same activities and land uses which have eliminated habitat and caused disturbance during critical life-cycle periods for sage grouse have also resulted in impacts to many other species. The removal of these areas from certain land uses will provide opportunities for passerines, raptors, reptiles and some game species. Similar efforts will be realized on private property as conservation easements for sage grouse are established.

Site-specific Efforts within Nevada

Partners for Conservation & Development

The Nevada Partners for Conservation and Development (NPCD) was formed in 2010 to provide leadership and a forum for collaborative, landscape scale and scientifically based habitat restoration program in Nevada. The NPCD is using the highly successful Utah Partners for Conservation and Development (UPCD) and the Utah Watershed Restoration Initiative (WRI) and see http://wildlife.utah.gov/watersheds/ as the models for Nevada.

Through time, it has become increasingly evident that individual agencies and entities operating solely within their own jurisdictions has not resulted in the highest ecological quality habitat. Further, the standard "top-down" approach often employed by agencies has likewise not translated into highest quality habitat. The UPCD and WRI model provides strong evidence that working in a genuinely collaborative and cross boundary fashion will show results in the form of increasingly healthy habitat and the ability to respond to large ecological problems. One example is the Milford Flats fire. The UPCD/WRI was largely responsible for the availability of seeds, equipment and personnel so that the spatial extent of that fire was addressed quickly. To date, the UPCD/WRI has treated about 1,800,000 acres of public and private land employing the best science and common sense methods.

From the outset the NPCD has made every effort to include all stakeholders and to put the onus for project ideas, proposal generation and implementation at the local level while ensuring there is support from all the major agencies, NGOs, researchers and others at the state level. This "ground-up" approach is a significant reason why the Utah programs have been so successful and have garnered support from the general public.

A large part of the NPCD's habitat project process includes ensuring that each project is reviewed in the context of NDOW's Wildlife Action Plan and other plans relevant to the project's focal species or focal habitat type. Other plans may include the local BLM's Resource Management Plan, an individual ranch's land management plans, NRCS conservation plans or the recovery plans for a species listed under the Endangered Species Act.

Current Project Work

The NPCD is involved in numerous projects across northern Nevada. The main focus of current project work is within the sagebrush vegetation types. The NPCD intends to expand into the Mojave and all vegetation types across Nevada. Examples of ongoing projects include:

- Clover Fire Revegetation in and Tuscarora Mountains
- Monitor Range prescribed burning
- Paradise Valley medusahead treatments
- Double H Range post fire revegetation
- Pine Nut Mountains PJ thinning and aspen treatments
- Desatoya Range PJ thinning and riparian area treatments
- Overland Pass of the Ruby Mountains sagebrush habitat restoration
- Lincoln County PJ thinning
- Rye Grass Fire revegetation in the Kern Mountains
- China Camp sage grouse lek restoration
- Long Doctor sage grouse lek restoration
- Spruce Mountain PJ thinning and springs restoration

- Schell Creek Mountains (east bench) mule deer/sage grouse habitat restoration

Memorandum of Understanding

The NPCD has formal agreements in place that set the tone for cooperation, leveraging of resources and to foster more open communication. Signers of the MOU include: BLM, US Forest Service, US Fish and Wildlife Service, NRCS, Bureau of Indian Affairs, Agriculture Research Service, Rocky Mountain Research Station, NV Dept. of Agriculture, NV Dept. of Conservation and Natural Resources, NV Division of Forestry, NV Division of State Lands, NV Division of Conservation Districts, NV Dept. of Wildlife, NV State Historic Preservation Office and various UNR Departments.

NGOs such as Nevada Bighorns Unlimited, the Nevada Mining Association, the Nevada Cattleman's Association, various weed districts, cooperative weed management areas, individual landowners and other citizen groups are participating at all levels within the NPCD.

WAP and USFS Forest Plans and BLM Resource Management Plans

Resources addressed in USFS Forest Plans and BLM Resource Management Plans include wetland and riparian resources, wild horses, biological diversity, forage production, forest health, watershed conditions, wildlife habitats, recreation, and invasive weeds, among others. During implementation, opportunities exist to provide WAP guidance and recommendations into these plan revisions. During implementation, a mechanism to build WAP and BLM RMP coordination will be further developed through BLM and WAP Implementation Team collaboration with opportunities for input by wildlife conservation partners and stakeholders. In the same manner, a mechanism to build WAP and USFS Forest Plan coordination will be further developed through Forest Service and WAP Implementation Team collaboration, with input from partners and stakeholders encouraged. Key to success in meeting the overall intent of Nevada's WAP will be the commitment within land use plans to the monitoring and adaptive management actions identified.

National Wildlife Refuge Comprehensive Conservation Plans

NDOW and USFWS have been close partners in refuge management in Nevada for almost six decades. For instance, the Stillwater National Wildlife Refuge was originally named the Stillwater Wildlife Management Area and was co-managed by NDOW and USFWS until the Truckee-Carson Settlement Act of 1990 transferred ultimate management authority distinctly to the USFWS. Today, Stillwater NWR and NDOW still cooperate very closely in the areas of water procurement and management for Stillwater and the Carson Lake Wetlands, the two primary wildlife wetlands within the Lahontan Valley Wetlands complex. The management of non-migratory game animals on the Sheldon NWR and the Desert National Wildlife Refuge complex is also very much a cooperative venture between the two agencies. Therefore, it is very important that the two agencies act as partners in the implementation of the Refuge Comprehensive Conservation Plans (CCPs), a System-wide planning process sparked by the passing of the National Wildlife Refuge Management Act of 1997. To date, the Stillwater NWR CCP and the Desert Refuge Complex have completed CCPs while the Sheldon NWR is in the final stages in the Sheldon NWR CCP process which is due to be completed in early 2012. Ruby Lakes NWR CCP is in the preliminary development stage and is scheduled for completion by 2013.

The pathways for WAP input into CCP development and implementation would include that of providing scientific support to the development of various management alternatives. The WAP would primarily assist in the identification of key wildlife ecological processes for priority management attention and the development of projected species outputs associated with various management scenarios resulting in different habitat acreages and management schemes. While objectives in the Stillwater CCP appear to be almost wholly habitat-based, the WAP could assist in the interpretation of habitat-based management objectives into wildlife population outputs that would contribute to statewide, regional, and continental population objectives. The WAP could assist in the analysis of the impacts of various visitor services alternatives, and through the development of best management practices, inform the process of selecting the visitor management strategy best suited for each Refuge. The WAP could also assist in the development and coordinated implementation of Refuge monitoring strategies, particularly with respect to coordinating Refuge monitoring methods and priorities with statewide, regional, or continental monitoring frameworks.

WAP and Tribal Lands Conservation

With the availability of Tribal Wildlife Grant (TWG) funds, a sister program to State Wildlife Grants, and access to Wildlife Habitat Incentive Program (NRCS), the opportunities to build effective wildlife conservation programs on tribal lands in Nevada are better than ever before. It appears there is also a unique opportunity for the Nevada WAP Implementation Team to provide valuable services to tribal conservation programs through planning assistance and coordinated scientific support. During the review period of the 2005 WAP, Tribes were given the opportunity to contribute their ideas on improving the coordination between NDOW and Nevada tribes. The strongest message that came across was the direct need for improved communication between NDOW and the tribes individually. The following is a small list of potential projects for coordination with Nevada tribes based on their current interests, issues, or existing programs:

- Wildlife strategy for big game management
- Wetland restoration
- Invasive species management
- Wetland grazing plan development
- Management of nesting migratory birds
- Biological program developments – hire biologists; buy equipment, etc.
- Resource inventory – reptiles, amphibians, and small mammals specifically mentioned
- Native plant conservation
- Reservoir fisheries management
- Greater Sage-Grouse conservation and land acquisition
- Off-highway vehicle encroachment
- Pipeline revegetation - best management practices being implemented for revegetation and recruitment of native plant species
- Spring habitat restoration – endemic fishes
- Reintroduction of Lahontan cutthroat trout into native waters
- Endangered butterflies

WAP and County Resource Planning

Over the last decade, Nevada's counties have expanded their role in the management of wildlife resources within their boundaries considerably beyond their traditional involvement of participation in the County Advisory Boards to manage wildlife that provide assistance, guidance, and local input into the management and harvest of game and sport fish. Two major conservation planning structures have facilitated the growth of county wildlife conservation planning – habitat conservation planning (HCPs), largely driven by concerns about the mutual impacts upon one another of urban/industrial development and endangered species conservation, and Greater Sage-Grouse planning within its range. The success of the local implementation model developed for the Governor's Greater Sage-Grouse Conservation Strategy and the phenomenon of county-proposed land bills that identify federal lands suitable for disposal to private development will continue to drive county interest in addressing their own wildlife conservation issues. Other key county planning processes for which wildlife conservation support could be provided include county master plans and public lands policy plans. In addition to maintaining working relationships with county planners, WAP products and services could also be made available to Public Land Use Advisory Committees (PLUACs).

The WAP is uniquely positioned to provide comprehensive wildlife planning and implementation services to county planning processes through the integration of species-based objectives and strategies into HCPs, sage grouse habitat restoration, and other issues certain to develop over time. It is also the intent and purview of the WAP to develop products and services that will assist local planning groups with the assessment, monitoring, and conservation of Species of Conservation Priority. The WAP Implementation Team can develop the support services and products and introduce them into local planning processes through the field personnel of the WAP partnership (NDOW, Nevada Natural Heritage Program, The Nature Conservancy, Lahontan Audubon Society). Because there are other county planning processes that would also benefit from WAP products and services (e.g., Quality of Life Plans, other open space and recreation plans), it is important that the WAP Implementation Team build direct lines of communication to the various county planning departments very similar to the tribal conservation support model described above. The Nevada Division of State Lands has invested much program development into the facilitation of county planning, and Nevada Division of State Lands stands to be a critically important partner in the transfer of WAP knowledge and support into the county planning community. The delivery of this county-state collaborative model should be recognized as the result and primary achievement of Nevada Division of State Lands' investment into the development of the WAP through the Question One Conservation Bond grant that pulled the WAP Development Team together in the first place.

Private Lands and Natural Resources Conservation Service

Much of the conservation focus in Nevada in the last 30 years has been directed toward public lands, mainly because public lands make up approximately 86% of the Nevada land base; yet some of the most important wildlife habitats, most notably lowland riparian habitats are predominantly in private ownership. The current shift of management focus toward the management of larger land systems (the watershed is currently a popular land management unit being discussed) is revealing a need to incorporate the wildlife values contributed by private lands into the overall management scenario because these private lands contributions are often critical to and inextricable from the wildlife population needs of the larger landscape.

The USDA Natural Resources Conservation Service (NRCS), assisted by the local Conservation Districts, has a long history of providing land conservation services to private landowners, primarily agriculturalists. NRCS maintains a suite of resource conservation assistance programs, several of which have already been described elsewhere in the document (Wildlife Habitat Incentives Program – WHIP; Environmental Quality Incentives Program – EQIP; Wetlands Reserve Program – WRP; Conservation Security Program – CSP). There are now also private lands assistance programs available through the U.S. Fish and Wildlife Service and Federal Aid that are being administered either directly by USFWS (Partners for Fish and Wildlife) or through NDOW (Landowner Incentives Program). All of these programs focus on essentially the same customer base. All have the potential to become highly successful in Nevada, where financial support for the maintenance of wildlife values on private land is a relatively undeveloped concept. Success is particularly likely if the three agencies can successfully coordinate their efforts in a network drawing on varied funding sources. We believe that the Nevada WAP can help catalyze this interagency network through the provision of scientific support into the various internal planning systems. Potential services provided to the network include identification of key species and ecological processes supported by private lands into both the Nevada WHIP Plan (currently under development) and CSP, tailored for specific watersheds as they are approved for program action on an annual basis.

Applying Conservation Action

When the Wildlife Action Plan was first developed in 2005, the overarching goal was to maintain healthy, self-sustaining populations of Nevada's Species of Conservation Priority and their habitats, and the implementation of the WAP objectives and actions would support maintenance of Nevada's biodiversity. However the importance of monitoring implementation success was recognized as a critical element of conservation effectiveness. It was our full intent to monitor plan implementation at two levels – program development/application and species/habitat response. By analyzing our data, we fully intended to take what we were learning and adjust our priorities and actions as objectives were achieved or new priorities were identified (i.e., adaptive management). In the following revised adaptive management discussion, we take the opportunity to both report on how much of the monitoring target set in 2005 was realized as well as set a new monitoring target for the implementation period of this 2012 Revision.

In order to demonstrate the effectiveness of the 2005 WAP, we intended to establish indicators for monitoring which included tracking the creation or continuation of multidisciplinary teams, documenting funding for WAP projects, and evaluating community support through polling and/or levels of involvement in WAP implementation. Priority action was applied toward 1) the construction of internal program development structures to allow NDOW biologists to successfully pursue Action Plan implementation and 2) the activation of several external stepdown planning processes to provide Action Plan priorities and approaches through a series of multi-partnered efforts at regional and specific ecological system scales (Steptoe Valley Conservation Assessment, Nevada Wetlands Conservation Plan, etc.).

The second monitoring component of the WAP relates directly to biodiversity health, and the status of problems facing species and their habitats. Nevada's WAP provides a strategic framework for accomplishing species and habitat goals, and success can be directly measured through monitoring species and vegetative community response. The "Applying Conservation Action" chapter of the 2005 WAP outlined a process for prioritizing strategies, setting quantitative habitat and species objectives, designing research and monitoring programs, and partnering to set up on-the-ground implementation. Existing efforts already in place (mostly species-based) in 2005 were adopted by Nevada's WAP as the starting point, and supplementary monitoring needs were identified and described to cover the full range of concern and action.

In this Revision, we have attempted to set quantitative objectives for conservation action as part of the revision process rather than identify the task as a "next step". These quantitative objectives can be found in each Key Habitat chapter in the Conservation Strategies. Levels of complexity in the objectives were set using a sliding scale dependent on the quality of the data available. More specific objectives were set for species for which the available data were extensive and developed enough to project actual population estimates (e.g. birds and game mammals). Directional objectives (maintain, increase) were set for species for which the data were adequate to demonstrate general trends, (e.g. and "presence/absence"). The following discussions will be grouped by taxa to demonstrate how species conservation is likely to proceed from the design and application of projects, through the likely species monitoring programs to collaborative evaluation and adjustment. Following the various taxonomically-grouped monitoring and adaptive management sections is a description and summary of Nevada's Wildlife Action Plan Performance Indicators Project and how it will continue to provide adaptive management guidance to the Phase IV implementation of this Revision.

Birds

Conservation planning for birds at the continental and regional/state level is considerably advanced compared to other terrestrial species planning. Four major bird initiatives have continental plans in place (Partners In Flight North American Land Bird Conservation Plan; North American Water Bird Conservation Plan; U.S. Shorebird Conservation Plan; and North American Waterfowl Management Plan) and Nevada is currently covered by a complete suite of regional/state plans associated with those initiatives (Intermountain West Joint Venture Habitat Conservation Plan; Nevada PIF Bird Conservation Plan; Intermountain West Shorebird Conservation Report; Intermountain West Water Bird Conservation Plan). These bird conservation plans provide guidance and support to statewide or local conservation strategies by identifying species priorities, setting conservation goals and objectives, and providing technical support through the development of best management practices using up-to-date science. The bird conservation initiatives are also very active in the identification of potential funding opportunities and linkage of potential partnerships. Bird conservation strategies in Nevada's WAP were structured to link with the four bird conservation initiatives and contribute their conservation achievements toward regional and continental priorities and objectives.

Land Birds

Land Birds-Setting Conservation Objectives

The PIF North American Land Bird Conservation Plan (2004 PIF Plan) used the best population databases available (including 30 years of Breeding Bird Survey data) to assess population status and trend for 448 species of land birds occuring north of Mexico. From this massive population assessment, PIF has developed population estimates, directional species population objectives and species population conservation targets based on 30-year trend. These population estimates, objectives, and targets were "stepped-down" to the state level (Rosenburg, 2004), and provided to the states for support in the initial WAP development phases (pre-2005). Nevada's 2005 WAP stated "These support materials will be used in Nevada when quantifiable objectives for the bird Species of Conservation Priority are set during the Phase II implementation process." However, after performing habitat capability analyses at the local and statewide scales, the objectives of the 2004 PIF Plan have proven to be too difficult to adopt from continental to state scale. The opportunities to effect habitat improvement sufficient to "double the population" for almost all such species are too limited; therefore, the 2004 PIF Plan population objectives are limited in value to providing a general measure of degree of priority and need among and between species.

As part of the data analysis that informed the revision of the Nevada Comprehensive Bird Conservation Plan (2010), a "bottom-up" habitat capability inventory was performed using ten years of Nevada Bird Count data. that, Using habitat type acreage (SW ReGAP) and local breeding density estimates derived from the NBC point counts, statewide landscape-scale breeding population estimates were computed and reported for the priority species in the revised NCBCP. Population objectives for Species of Conservation Priority in this Revision were based on those population estimates along with applicable trend information from the USGS Breeding Bird Survey analysis. Where population estimates were set as targets, we generally chose to maintain the 2010 estimates; where trend was set as the target, we generally communicated a desire to "reverse a declining trend" or "maintain or increase current trend". Attempts to directly link objective achievement to the 2004 PIF Plan will be limited to general acknowledgement of priority based on relative conservation need.

Land Birds-Project Development and Implementation

Bird conservation projects will be designed to meet the State's most pressing bird conservation needs and prioritized by an integration of local and continental priorities. Species with significant downward trends that have been assigned directional objectives in the PIF North American Land Bird Conservation Plan (NABCP) of "100% increase" and "50% increase" will likely receive priority for project development in Phase IV implementation. Those species are listed below by ecoregion:

Priority Species from the PIF NABCP that occur in Nevada with directional objectives of "increase 50 or 100%" (in 30 years).

Great Basin and Columbia Plateau - Bird Conservation Region 9		
Species Common Name	***PIF Objective***	***Primary Key Habitat***
Dusky Grouse	increase 100%	Intermountain Coniferous Forests and Woodlands
Brewer's Sparrow	increase 100%	Sagebrush
Greater Sage-Grouse	increase 100%	Sagebrush
Olive-sided Flycatcher	increase 100%	Intermountain Coniferous Forests and Woodlands
Pinyon Jay	increase 100%	Lower Montane Woodland
Short-eared Owl	increase 100%	Marshes
Willow Flycatcher (adastus)	increase 50%	Rivers and Streams
Mojave Desert - Bird Conservation Region 33		
Species Common Name	***PIF Objective***	***Primary Key Habitat***
Bell's Vireo	increase 100%	Mojave Rivers and Streams
Bendire's Thrasher	increase 100%	Mojave Mid-Elevation Mixed Desert Scrub
Black-chinned Sparrow	increase 50%	Lower Montane Chaparral
Willow Flycatcher (extimus)	USFWS recovery plans	Mojave Rivers and Streams
Dusky Grouse	increase 100%	Intermountain Coniferous Forests and Woodlands
Sierra Nevada - Bird Conservation Region 15		
Species Common Name	***PIF Objective***	***Primary Key Habitat***
Sooty Grouse	increase 100%	Sierran Conifer Forests and Woodlands
Olive-sided Flycatcher	increase 100%	Sierran Conifer Forests and Woodlands
Rufous Hummingbird	increase 100%	Alpine and Tundra
Spotted Owl	USFWS recovery plans	Sierran Conifer Forests and Woodlands
Tricolored Blackbird	increase 100%	Marshes
Willow Flycatcher (brewsteri)	increase 50%	Rivers and Streams

A short list of local priority species added from the Nevada PIF Bird Conservation Plan may include:

Species Common Name	PIF Objective	Primary Key Habitat
Northern Goshawk	300 nesting pairs	Aspen Woodland
Ferruginous Hawk	stable/increasing	Lower Montane Woodland
Golden Eagle	maintain	Cliffs and Canyons
Bobolink	stable/increasing	Wet Meadows

The species listed above will not be the only species prioritized for conservation effort in Phase IV implementation. If actions from the key habitat strategies are prioritized according to this list of priority bird species, the first-order projects designed in Phase II might include:

- Restore degraded sagebrush to healthy range condition
- Restore Mojave desert scrub to healthy range condition
- Science-based piñon-juniper management strategy that maintains high quality piñon-juniper wildlife habitat while manipulating its distribution in sites where it has encroached into sagebrush sites
- Riparian habitat restoration
- Securing more water for wetlands
- Retain old growth/late successional stage forest
- Treatment of second growth forest to enhance attainment of old growth/late successional classes
- Aspen stand regeneration

High priority wildlife research and inventory needs for this list of birds identified in Nevada's WAP include:

- Distribution and population status of *brewsteri* and *adastus* subspecies of Willow Flycatcher
- Habitat suitability models for sagebrush birds relative to Greater Sage-Grouse management action
- Statewide Dusky/Sooty Grouse population assessment
- Pinyon Jay nest colony site selection/multi-year nesting dynamics
- Population assessment for Bendire's Thrasher
- Assessment of current aspen stand condition relative to Northern Goshawk nest site suitability
- Development of effective restoration techniques for Mojave Desert shrub

Land Birds – Monitoring, Adaptive Management, Partnerships

Land bird monitoring is already in place in Nevada via the National Breeding Bird Survey and the Nevada Bird Count. In addition to long-term population monitoring, the Nevada Bird Count is designed to focus some of its resources on the investigation of bird/habitat relationships with the eventual objective of constructing habitat suitability models for key species adequately monitored by the survey. These habitat suitability models will have habitat states and transitions built into them so that land managers will have the ability to predict multi-species population responses to land management actions, as well as the capability to make assumptions about habitat health by assessing the bird community found on the site in question.

Birds are relatively easy to monitor when compared to other taxa, and for this reason it makes sense to incorporate bird monitoring protocols in measuring the effectiveness of habitat improvement projects. Quantitative assessment tools were developed after the completion of the 2005 WAP using density information from the Nevada Bird Count to assist biologists and land managers in communicating the projected bird population benefits of habitat improvement projects (e.g., a 4,000 hectare sagebrush improvement project that increased Brewer's Sparrow breeding density from 10 birds per 40 hectares to 20 birds per 40 hectares would add 1,000 new pairs of Brewer's Sparrows to the population).An to deliver quantitative assessment tools is currently underway following the completion of the Nevada CBCP being administered by the Great Basin Bird Observatory. We still believe bird monitoring supported by these same quantitative assessment tools is one of the best available biometric tools for project effectiveness monitoring after projects have been implemented.

The Nevada Bird Count is multi-agency funded and scientific oversight to the program is provided by Nevada Partners In Flight, which is also supported by all the major resource agencies, conservation organizations, and academic institutions in the state. The Intermountain West Joint Venture will play a key role in building the funding partnerships necessary to effect large-scale habitat improvement on behalf of bird conservation in the state. County planning teams with multi-agency support, whether focusing on Greater Sage-Grouse in the north or on multi-species conservation in the south, are expected to continue to be major implementors of habitat improvement on the ground.

Water Birds and Shorebirds

Water Birds and Shorebirds - Setting Conservation Priorities

Population sizes for water birds and shorebirds have not been estimated at the continental level with any great degree of precision, and state population estimates have not been calculated and "stepped down" as have land birds. Population estimates and breeding population targets for water birds have been generated in the Intermountain West Waterbird Conservation Plan, and they can be refined at the state level with proper coordination between monitoring efforts, which is the aim of Great Basin Bird Observatory's Aquatic Bird Count (GBBO 2004). Shorebird breeding population estimates will be very difficult to generate, but migration populations at key staging sites can be constructed with a concerted inventory effort over a complete ten-year drought cycle. Such data are available for the Lahontan Valley Wetlands where peak migration shorebird counts have been conducted since 1986.

Population estimates for shorebirds and water birds were generated using local data rolled up to statewide scale. Implementation of Nevada's WAP and will be based on a calculated capability of hitting 10-year peak projections (because of the cyclic nature of Nevada wetlands).

Water Birds and Shorebirds – Project Development and Implementation

Again, for aquatic birds, bird conservation projects will be designed to meet the State's most pressing bird conservation needs and prioritized by an integration of local and continental priorities. Bird Species of Conservation Priority in the Intermountain West identified as of High or Moderate Concern (Water Bird Plan) or of High or Moderate Importance (Shorebird Plan) are listed in the table below.

Key habitat strategies for Marshes, Desert Playas and Ephemeral Pools, Lakes and Reservoirs, Intermountain Rivers and Streams, and Mojave Rivers and Streams are most relevant to the conservation of these species. Key research and inventory needs identified in Nevada's WAP include:

- Statewide population assessment of Least Bittern
- Statewide population assessment of Yuma Clapper Rail
- Statewide surveys for breeding shorebirds
- American White Pelican post-breeding dispersal and regional colony connectivity

Water Bird and Shorebird Priority Species for all ecoregions in Nevada

Intermountain West Waterbird Conservation Plan

Water Birds

High Concern	***Objective***
Greater Sandhill Crane	TBD
Black Tern	550
American White Pelican	12,620
Common Loon	1,000
Yuma Clapper Rail	TBD
Moderate Concern	
Least Bittern	TBD
White-faced Ibis	12230

Shorebirds

High Importance	
Snowy Plover	breeding
American Avocet	breeding
Long-billed Curlew	breeding
Long-billed Dowitcher	migratory
Moderate Importance	
Western Sandpiper	migratory
Red-necked Phalarope	migratory

Water Birds and Shorebirds – Monitoring, Adaptive Management, and Partnerships

Monitoring for water birds and shorebirds will occur throughout a network of important sites via the Aquatic Bird Count administered by Great Basin Bird Observatory. Conservation targets for species will be developed for each site and accumulated into statewide targets, which in turn will be contributed to coordinated wetland bird objectives at the regional level as a coordinated wetland bird management network is developed for the Intermountain West (Oring et al., 1999). Unlike land birds, area-density calculations for wetland birds are not useful in measuring site productivity or project performance. Conservation effectiveness will be measured on a site-by-site basis in terms of total birds using the site and will likely have to be adjusted for consideration of climatic cycles. For example, sites or projects will be evaluated in terms of increases in peak bird numbers, increases in bird numbers at the low point in the climatic cycle, or possibly in the "flattening" of the oscillations between lows and highs through the increased stability of available habitat. Aquatic bird monitoring schemes will need to be somewhat flexible to accommodate the irregular nature of breeding shorebird populations – a rotation scheme that tries to put breeding population surveys on a fixed interval is not flexible enough to catch the most important breeding years, which can crop up with very little notice, but are generally coincidental with high water years.

The aquatic bird partnership is similar to that of land birds through multi-agency support of GBBO and Nevada Partners In Flight. An aquatic bird monitoring working group was convened by NDOW and GBBO in 2002 and has been working on implementation of the Nevada Aquatic Bird Count since then. This aquatic bird working group consists of NDOW biologists, USFWS refuge biologists, USFS, BLM, and University of Nevada researchers. The full-scale project has yet to be implemented, but progress toward full implementation has been steady since the group's inception. The Intermountain West Joint Venture will play a key role in wetland and riparian habitat improvement through North American Wetlands Conservation Act grant projects and IWJV Cost-Share grants.

Habitat improvement will proceed through the efforts of staff from National Wildlife Refuges, Nevada Wildlife Management Areas, BLM, USFS, BOR, NRCS, Nevada State Parks, and county working groups.

Waterfowl

Waterfowl – Setting Conservation Objectives

Waterfowl population sizes are closely monitored by the states and the federal governments of the U.S., Canada, Mexico, and Russia. Population estimates are generated through established consultation structures called Flyways. Nevada is a member of the Pacific Flyway Council and its technical arm, the Pacific Flyway Study Committee. The 2004 update of the North American Waterfowl Management Plan (NAWMP) presents continental population estimates and objectives for all duck species and goose populations. Waterfowl population objectives for this WAP Revision were set for seasonal occurrence using ten-year averages from the statewide waterfowl survey datasets.

Waterfowl – Project Development and Implementation

Project development for the attainment of waterfowl objectives will be predominantly wetland based; therefore it is easily integrated with the water bird/shorebird project development approach. Waterfowl habitat improvement projects are less likely to be driven by individual species objectives than group-based – e.g. dabbling ducks, diving ducks, geese and swans – although individual species breeding objectives such as Cinnamon Teal in montane meadows might be identified to integrate waterfowl habitat improvement with other initiatives such as Greater Sage-Grouse conservation.

Waterfowl – Monitoring and Adaptive Management, and Partnerships

Waterfowl monitoring in Nevada consists of four aerial surveys that are connected to the continental survey strategy – December swan surveys, mid-winter inventory, goose pair surveys, and duck pair surveys. Survey results are forwarded to the U.S. Fish and Wildlife Service through the Pacific Flyway Council. Nevada's breeding population surveys were modified in 2009 to align them with the western mallard adaptive harvest management (AHM) strategy currently endorsed by The Pacific Flyway Council (PFC) and implemented by the U. S. Fish & Wildlife Service (FWS). The current breeding population survey deploys a stratified random site sample framework with specific stratum sampling objectives (e.g. 40% rivers/lakes/reservoirs; 10% agriculture; 10% marsh; etc. Two Nevada marsh sites (Carson Lake and Stillwater marshes) receive 20% coverage to generate more precise estimates for cinnamon teal and redhead.

Survey results are analyzed by the U.S. Fish and Wildlife Service and harvest recommendations are made by the Pacific Flyway Study Committee made up of representatives from all the Pacific Flyway state wildlife agencies and key personnel from the USFWS Migratory Bird programs in Pacific Flyway administrative regions. This committee also develops species management plans based on need.

Waterfowl – Partnerships

Waterfowl and wetland conservation are facilitated by the North American Waterfowl Management Plan (NAWMP) and its implementation arms, the Joint Ventures. A NAWMP revision began in 2009 with an expected completion date of 2012. The new revision's intent is to provide a more inclusive purpose for waterfowl conservation that will reflect the full range of fundamental goals of Plan stakeholders and result in collective agreement on the desired future state of waterfowl management across North America. The Intermountain

West Joint Venture is Nevada's NAWMP implementation partner over most of the state working in close collaboration with Ducks Unlimited's Sacramento office. Key action groups within the state include the Nevada Waterfowl Association and the Nevada Wetlands Coalition. These four groups are available for planning, design, funding support and implementation of the full range of projects relevant to waterfowl conservation.

Mammals

Conservation planning for game mammals has been in place at NDOW for over 50 years because of the intensive demands of harvest management. For the purposes of the WAP, mule deer and bighorn sheep conservation strategies will follow the course set by existing management plans updated on an as-needed basis. The mammal Species of Conservation Priority classified as "furbearers" in Nevada Administrative Code (northern otter, American marten) have not received priority planning emphasis in the past. Collaborative conservation planning for nongame mammals in Nevada has taken a significant step forward with the completion of the Nevada Bat Conservation Plan, but planning for other species is lacking or in rudimentary stages of development.

Bighorn Sheep

NDOW's Bighorn Sheep Management Plan was completed in 2001 and currently guides conservation action for bighorn sheep in the state. The Nevada Department of Wildlife's Game Division is currently working on a "Sheep Separation Strategy" in cooperation with Nevada's woolgrowers and federal land management agencies to address issues related to potential disease interactions between wild bighorn sheep and domestic sheep.

Bats

Completed in 2006, The Revised Nevada Bat Conservation Plan presents conservation strategies for all 23 species of bats found in Nevada, of which 13 are Species of Conservation Priority in the WAP. Priority Phase II implementation action centered around the integration of bat surveys with Abandoned Mine Land closure projects of the Bureau of Land Management, Forest Service, and Nevada Division of Minerals. This program is projected to also provide the major impetus for bat survey work in Phase IV WAP implementation.

Bats delineate into four basic groups based on their roost behaviors – subterranean roosters (mines and caves); forest roosters (conifer, woodland, riparian); cliffs/talus roosters; and man-made structure roosters (buildings and bridges). These four roosting groups can then be divided into three basic strategy groups because man-made structures can be included in a subterranean conservation strategy – subterranean/structure; forest; cliffs/talus.

- ***Subterranean/Structure Conservation Strategy***

Priority Species
California leaf-nosed bat
little brown myotis
fringed myotis
cave myotis
Allen's big-eared bat
Townsend's big-eared bat
Mexican Free-tailed bat

Inventory

The Abandoned Mine Lands closure program has provided the structure for what may eventually develop into a comprehensive statewide survey of caves, mines, and structures in Nevada. Key elements of such an inventory continue to include the identification and GIS mapping of key roosting sites – maternity, hibernacula, lekking, and migratory staging – across the state for the entire suite of bat Species of Conservation Priority in this strategy group.

Selection of the Monitoring Network
Roost sites would be prioritized in order of importance to each species (roost size, percent of total inventoried population), and the key sites for each species will be included so that all are significantly part of the monitoring strategy. These sites would likely have been secured through bat-friendly closures, uniquely lending them to long-term monitoring. An integrated monitoring protocol that combines the various strengths of the array of techniques – acoustic (ANABAT), exit counts, net capture, and internal roost counts – would then be applied to the priority network of sites.

Setting Population Objectives
Upon implementation of the monitoring network, quantifiable conservation objectives could then be set by species for the cumulative populations of the site network, with a baseline objective of "no decline" and after management action points are identified, percentage increases in total population by species. In this instance, the act of bat-friendly closure could be expected to produce an increase by site over time, as unprotected sites continue to experience disturbance and closure and displaced bats find the protected sites.

Research and Conservation Action
Once the key roost sites are secured, research investigations can be initiated to find the key habitat elements and foraging sites associated with each roost. This knowledge can then be used to develop a conservation strategy for each roost that includes treatments of habitat intended to improve conditions. Species response to conservation actions can be documented through the monitoring protocol, and conservation objectives can be adjusted based on findings.

- ***Forest/Woodland/Riparian Conservation Strategy***

Priority Species
western red bat
silver-haired bat
hoary bat long-eared myotis

Inventory
Because of the dispersed nature of forest-roosting bats, a site-based comprehensive inventory will be more difficult to achieve than one for subterranean sites. An inventory of forest-roosting bats will require the implementation of a stratified random sample of suitable habitat (conifer forest, lower montane woodland, aspen, riparian) with an initial acoustic survey assessment followed by capture network at selected water sources. Captured bats will be fitted with radios and tracked to their roosts.

Habitat Suitability Models For Roosting Habitat
Upon delineation of the key forest-roosting sites as identified by the bats themselves, key roosting landscapes would be identified and prioritized for each species. Habitat suitability models will be constructed for roosting habitat in all the pertinent key habitats.

Conservation Action and Performance Monitoring
Barring significant unforeseen advances in technology, it is unlikely that forest bat monitoring will be able to produce reliable trend results through this WAP planning period; therefore, the conservation strategy for forest bats will rely on the translation of the habitat suitability models into habitat management strategies implemented through BLM Resource Management Planning and Forest Service Forest Plan processes. The provision of suitable roosting habitat on all priority landscapes will be the sole conservation action. Conservation success will be measurable only in terms of persistent species presence in a selected management area. Roosting sites are expected to shift with time as habitat conditions transition from one state to another, and as bat populations respond to an array of ecological factors, some of which are not forest-habitat-related. Long-term monitoring is likely to occur at some appropriate interval using the same integrated protocol described above. Shifts in site priority will be documented and conservation action will be adjusted appropriately.

➢ *Cliffs and Talus Conservation Strategy*

Priority Species
western small-footed myotis spotted bat

Inventory

Cliffs and cliff complexes are fairly easy to identify and target for a statewide inventory, but talus slopes, for example, in piñon-juniper habitat, are much more extensive and dispersed across the landscape, so the Cliffs and Talus inventory strategy will require a two-phase approach, including a comprehensive statewide inventory of cliffs and a stratified random sample of talus slopes. Survey protocol will be similar to the forest bat strategy – integrated use of acoustic survey equipment to determine presence, capture net activity to determine rough population demographics, and radio telemetry to track individuals back to their roosts.

Selection of the Monitoring Network

Important roost sites would be identified and prioritized for each species. These sites would form the basis of a cliffs/talus monitoring network where the integrated monitoring protocol would be implemented on a regular basis at some appropriate interval.

Conservation Action and Performance Monitoring

As the important cliff and talus roost sites are identified, they can be proposed for priority management in the appropriate land management agency land use planning process. Priority management for these sites should start with fairly passive strategies such as identifying the priority areas on RMP or Forest Plan maps, with a consensus-based progression of protective measures developed to address elevating levels of disturbance or threat. Key human activities to be monitored are rock-climbing activity and decorative rock removal. Conservation action triggers should be identified to initiate appropriate protective action based on intensity of the threat. Performance monitoring would be similar to the forest bat strategy – persistent presence being the key biometric.

Partnerships in Bat Conservation

The Nevada Bat Working Group is comprised of biologists from state and federal agencies, university biologists, and private consultant biologists. Key to the success of the three bat conservation strategies are the involvement of Nevada Department of Minerals and the Nevada Bureau of Mines and Geology; federal agency staff in minerals, recreation planning, range and forestry; spelunking and rock-climbing clubs; the Nevada Mining Association and individual mines. Monitoring protocols are likely to remain under the leadership of NDOW, Nevada Natural Heritage Program, university researchers and key private consultant biologists.

Small Mammals

Following the completion of the 2005 Wildlife Action Plan, significant inventory and study time was expended on several of Nevada's limited-distribution small mammal species, including:

- pygmy rabbit
- American pika
- dark and pale kangaroo mouse
- Humboldt yellow-pine chipmunk
- Hidden Forest chipmunk
- Aplodontia
- northern flying squirrel
- Pahranagat Valley montane vole
- Ash Meadows montane vole

- Fish Spring botta pocket gopher
- San Antonio botta pocket gopher

Much of the work involved “rediscovering” species or subspecies that had not been surveyed in decades and applying modern genetic analysis on tissues to update taxonomic status since E. Raymond Hall’s highly morphological species delineations from the 1930’s. Two species, Ash Meadows montane vole and Hidden Forest Uinta chipmunk, were searched for and not found and may be extinct. Recent field and genetic studies of the kangaroo mouse complex have resulted in a significant rearrangement of taxonomy for the genus in Nevada, causing a shift in how we address conservation concerns in the WAP.

Inventory

The following small mammal Species of Conservation Priority should receive further attention in this plan revision period:

- Five species of shrews
- Mountain pocket gopher
- Sagebrush vole
- Shadow (Allen’s) chipmunk
- Western jumping mouse
- Wyoming ground squirrel
- Desert pocket mouse

Conservation Action and Monitoring

Small mammal species will be evaluated for the degree of conservation protection they will require to maintain population viability, and proper recommendations to adjust their conservation status under Nevada Administrative Code will be made. Conservation plan development will then proceed through population viability analysis, identification of current and potential suitable habitat, identification of conservation partnerships, and the development of a collaborative action plan. Key habitat types of particular importance to this group of species as a whole include:

- Intermountain Rivers and Streams
- Sagebrush
- Grasslands and Meadows
- Intermountain Coniferous Forest and Woodlands
- Mesquite Bosques and Desert Washes

Conservation objectives will be set, appropriate strategies will be implemented, and monitoring will occur as needed as a function of conservation plan development.

Statewide Performance Indicators Small Mammal Monitoring Network

Small mammal species of Conservation Priority will be inventoried and monitored via the Wildlife Action Plan Performance Indicators project for sagebrush and Mojave desert habitats.

Conservation Objectives and Project Development/Implementation

The small mammal monitoring element of the Sagebrush Performance Indicators project designed by the Wildlife Action Plan Sagebrush Technical Advisory Team (2010) uses presence/absence statistical methodology to detect population trends from small mammal trapping results (reference needed If the performance indicators survey work begun in 2010 can be continued, the next revision of the WAP should be able to set specific quantitative objectives for small mammals of conservation priority using occupancy rates from the survey dataset. Habitat improvement projects will be designed to meet the life history needs of the suite of Conservation Priority species occurring at the site and applied through the appropriate land use planning venues, likely bundled into landscape treatments with Species of Conservation Priority from other taxonomic groups.

Monitoring, Adaptive Management, and Partnerships

The permanent grid of small mammal monitoring sites is expected to be maintained to document presence, statewide population demographics, and shifts in distribution. Site-specific monitoring on treated landscapes will measure project effectiveness while contributing to the statewide database.

To date, the partnership for the conservation of small mammals is in its very early stages. The Nevada Natural Heritage Program has been very successful in convening a small working group of mammalogists to refresh Natural Heritage scores (2003) and to provide expert input into the mammal assemblages used in this WAP (2005). This working group exhibits considerable dual membership with the Nevada Bat Working Group, and in cooperation with the technical advisory committees that are developing performance indicator methodology for sagebrush and Mojave desert habitats should be expected to provide expertise and leadership in the small mammal conservation effort. NDOW, BLM, Forest Service, USFWS, University of Nevada staff from both major campuses and some satellite campuses, NNHP, USGS-BRD, Southern Nevada Water Authority biologists, and biological consultants are just a few of the regular attendees. Implementation partnerships with state and federal land managers and private landowners assisted by NRCS and USFWS Conservation Planning Tools will be required to implement small mammal conservation in the field.

Carnivores

Priority Species
American marten
northern river otter

These two mustelids have been retained for Wildlife Action Plan conservation attention in the 2012 Revision, while Sierra Nevada red fox, kit fox, and ringtail have been deactivated from the list. Both marten and otter are classified in Nevada Administrative Code as furbearers, although neither contributes significantly to the trapping economy in Nevada. American marten are closed season, and have not been trapped legally in Nevada in years. Open seasons for river otters still occur on the Humboldt River system.

Inventory and Monitoring

Espinosa (2002) and Catalano (2009) have successfully documented American marten visitation to camera stations in the Carson Range. Population densities in Nevada are so sparse that more detailed study involving radio-tracking etc. are not considered to be cost-effective at this time. River otters have been successfully documented via riverbank tracking surveys (Bradley 1986). Baited camera station surveys will continue to be implemented in marten habitat to monitor distribution and rough relative abundance. Current monitoring needs for otter have not been assessed.

Conservation Strategy

The conservation needs of these species in Nevada are not very well understood at this time, so conservation strategies for each species would vary with the details of the knowledge gained from inventory and monitoring. The American marten is the most restricted species of the two. Conservation of this species would likely entail assessment of potential suitable habitat using the latest habitat suitability models, a calculation of the number of potential territories in the Carson Range, followed by efforts to document presence/absence in all potential territories. A rough population size might be projected based on the findings, and population viability analysis would be applied to determine the feasibility of maintaining Carson Range habitat in marten-capable condition. Any PVA of American marten in Nevada must consider linkage to California populations as a source.

Otter conservation is generally understood to be linked with good riparian habitat stewardship in the Humboldt River system. Otters are usually found in productive stretches of river with healthy willow and meadow habitats along their banks that support diverse wildlife communities and productive fish populations in the river itself.

Partnership
The partnership to implement the conservation strategy for small carnivores would include NDOW biologists from both the Game and Wildlife Diversity Bureaus, mammal experts from the mammals working group described above, the Nevada Trappers Association and other sportsmen's organizations, state and federal land management agencies, and tribes.

Reptiles

As a taxonomic group, reptiles have received the least amount of planning emphasis and are among the hardest to develop adaptive management strategies because of the difficulty of inventorying and monitoring them. The exception in Nevada is the desert tortoise, of which its listing under the Endangered Species Act in 1990 initiated massive planning efforts that culminated in the development of the Clark County Multiple Species Habitat Conservation Plan, the current archetype of local collaborative conservation planning in the state.

The ongoing permitted activity of commercial collection of most species of reptiles should require that adequate population monitoring protocols be in place to assess the capability of the resource to sustain harvest. The NDOW reptile program has consisted of a single biologist assigned primarily to reptiles in the entire state since 1985, and the demanding conservation priorities of the desert tortoise have overwhelmed this position since even before the 1990 listing, effectively forestalling the development of a responsive reptile monitoring and conservation program. The identification of 19 reptile Species of Conservation Priority in the 2005 WAP effectively initiated much-needed basic inventory work for Sonoran mountain kingsnake and pygmy short-horned lizard , but much more work remains to be done to implement a fully comprehensive reptile program. This Revision identifies 25 reptile Species of Conservation Priority (with the northern alligator lizard recognized as two subspecies Sierra and Shasta).

Comprehensive Inventory

Priority Species for Comprehensive Inventory
western banded gecko
desert iguana
Great Basin collared lizard
long-nosed leopard lizard
desert horned lizard
desert night lizard
western brush lizard

Reptiles as a group may be the most difficult terrestrial vertebrates to inventory and monitor. NDOW recently found a walking transect survey protocol based on visual observations to be inadequate because the surveys were labor-intensive and detection rates were low for all but the most common lizard species (NDOW 2003). Nighttime road surveys conducted in the spring after emergence have produced better results for nocturnal species, but have their implementation limitations, as well. Pitfall trap methodology was tested on a limited scale post-2005 WAP, but was discontinued due to more pressing program priorities. Other survey protocols may have promise, including walking or driving "berm" surveys that mimic commercial collectors' primary collection protocol – that of driving unpaved roads and collecting off the rocks and raised grader berm along the road margin. An integrated survey protocol using road surveys, pitfall traps, and habitat stratified visual surveys is expected to produce the most comprehensive results. From the integrated survey, an index will be derived that will reliably serve as a trend indicator to inform management action.

Single-species Investigations

Priority Species for Single Species Investigations
chuckwalla
Greater short-horned lizard
Pygmy short-horned lizard
Western red-tailed skink
Sierra and Shasta alligator lizard
Panamint alligator lizard
Gila monster
Sonoran mountain kingsnake
rosy boa

To accumulate the knowledge necessary to construct adequate conservation strategies for any of these species will require considerable focused effort on each individual species. Inventory protocol must be specifically devised and considerable search time should be dedicated. These investigations are more likely to be conducted as focused academic studies for Master's or Doctorate candidates. The highest priority species for such study at this time appear to be chuckwalla, Gila monster, Sonoran mountain kingsnake, and the recently discovered rosy boa. For instance, a priority research need for chuckwalla is to measure population response to commercial collection activity on Nevada sites using unharvested sites in California as study controls. Focused single-species investigations of the rest of this contingent may have to wait for issues of habitat loss, disease, or other concerns to elevate their conservation priority to the point of initiating action. In the meantime, information can be gathered from the literature and chance encounters that may be useful in constructing suitable habitat models for coarse-scale reptile habitat management.

Snakes

Priority Species for Integrated Snake Inventory
Ring-necked snake
Northern rubber boa
Mojave shovel-nose snake
Sidewinder
Smith's blackhead snake
Spotted leaf-nosed snake
Western threadsnake

In addition to rosy boa, seven new snake species have been identified as Species of Conservation Priority in the 2012 Revision. Six of these snakes share a suspected vulnerability to the impacts of habitat fragmentation that are certain to continue with urban development of Clark County now assisted by the installation of large tracts of solar panel energy fields proposed for the Mojave region. The seventh, the northern rubber boa, is a northerly distributed species that may suffer from the impacts of climate change on mesic habitats, particularly aspen. The six Mojave snakes listed here can be monitored collectively as part of a specifically-designed snake inventory that would set hypotheses relevant to documenting the degree and impacts of habitat fragmentation over the next ten years. Likewise, baseline inventory of northern rubber boa should be initiated and hypotheses relating to climate change and mesic habitat conditions set.

Partnership

The multi-agency initiative Partners in Amphibian and Reptile Conservation (PARC), modeled after the successful Partners In Flight effort for landbirds, has made significant advancements in nationwide and regional conservation planning for reptiles and amphibians. Participants include staff from NDOW, federal land management agencies, the University of Nevada system, and others. So far PARC has completed a best management practices manual for reptiles and amphibians as well as an exploratory document detailing the issues of commercial reptile collection and documenting the various regulations developed by the states to administer commercial collection. PARC is currently working on a species prioritization process modeled after Partners In Flight's landbird conservation assessment database. Developing working relationships with the commercial collectors is also paramount to devising functional collaborative conservation action for reptiles.

Aquatic Species

Fishes

Significant conservation planning efforts exist for fishes in Nevada, although the majority of these are focused on species which are already under Federal or State protected status. This does mesh well with the focus of priority conservation species in the WAP effort as there is a close parallel between existing protected status and high conservation need ranking in the species evaluation process for fishes. As would be expected from the typically sporadic and isolated distribution of aquatic habitats and associated fish species assemblages in Nevada's arid environment, conservation planning for aquatic species tends to be focused on individual species or assemblages, and their discrete and spatially isolated habitats, which is in contrast to the more regional approach which can be taken for some terrestrial species groups such as land birds. Although there are significant similarities in the threats and stressors to fishes across the state, such as invasive species and habitat alteration, which has allowed some commonalities between these individual conservation planning efforts, there has been little ability or need to link these efforts into larger regional approaches because of the uniqueness of conservation requirements for each aquatic system and species assemblage. However, the majority of these efforts share key partners and participants, which has encouraged the exchange of information and strategies across species and habitats to the benefit of individual conservation efforts. An important output of the Nevada WAP in this regard is its focus on key habitats and the need for coherent and implementable statewide partnership based strategies for habitat protection and restoration. To the extent that this strategy approach will encourage broad based benefits to aquatic habitats, existing and future individual fish conservation efforts will be enhanced.

Endemic Fishes

Setting Conservation Objectives

For the majority of fish species of conservation need, conservation objectives are defined at some level by existing recovery plans and documents, or have been developed by individual recovery teams or partnership-based recovery implementation teams (RITs). For many of these species, recovery plans produced by the USFWS are outdated or do not provide a level of detail adequate to direct recovery and conservation implementation, and individual RIT teams and working groups have developed recovery implementation plans and ecosystem conservation strategies which address priority conservation needs encompassing, where feasible, the full species assemblages within aquatic habitats where the priority species occur. Some gaps do occur in this coverage of available conservation planning, primarily due to limits on existing funding to support planning efforts, but to the extent that this guidance is available the Nevada WAP is linked to and defers to those existing efforts for species- or system-based conservation objectives. Where adequate conservation planning does not yet exist, the development of partner-based RIT and working groups and the formulation of those conservation strategies is a key action captured within the WAP aquatic key habitat descriptions.

Project Development and Implementation

Specific conservation actions are identified in existing recovery and conservation planning for the majority of the fish Species of Conservation Priority, where they are included under existing Recovery Team, RIT and conservation working group processes. An important element of these ongoing efforts has been the attempt to focus where feasible on actions and strategies to address threats and stressors affecting species assemblages and habitats on a broader system level, such as habitat fragmentation, and invasive species, which will maximize benefits to endemic fish assemblages rather than just select individual species of highest concern. The key habitat strategies for aquatic habitat types also identify important areas of focus for conservation actions, and in some cases identify gaps in this coverage where additional future efforts are needed to develop a structure for project definition and implementation, particularly for species or species assemblages and habitats which are not well covered by these existing conservation processes.

Monitoring, Adaptive Management and Partnerships

Monitoring programs are in place for the majority of the fish Species of Conservation Priority, generally conducted as status and trend assessments on an annual or biennial basis using methods and protocols developed by NDOW or partner working groups on an individual species or assemblage basis. Where gaps exist in this monitoring network, strategies to develop additional system-based conservation implementation teams are intended to address this deficiency. These implementation groups also serve a critical role by periodic, generally at least annual, review of conservation activities and status which provides an adaptive process to modify implementation actions and strategies as required.

Existing partnerships for fish conservation efforts, although largely subdivided into individual working RITs and sub-groups by the unique and isolated distribution of aquatic habitats and their associated species assemblages, are significant and broad based. Although leadership for individual conservation programs varies, with USFWS responsible for formal recovery team processes and RIT teams under the guidance of NDOW, federal agencies including BLM, the USFS, and USGS-BRD, and state and local partners including NNHP, conservation organizations and landowners play key roles on individual teams, particularly for the design and review of conservation strategies and in the implementation of conservation actions. For Colorado River endemic fishes, conservation strategies and actions are closely linked to rangewide planning and priorities encompassing neighboring states in both the upper and lower Colorado River Basin. Both USFWS and USBR (through the Lower Colorado Multi-Species Conservation Program) are key partners in identifying and implementing Nevada-specific conservation actions for those fish species.

Non-native Sport Fishes

Planning for important non-native sport fisheries is similarly well advanced, although this is focused primarily on the development and implementation of Fisheries Management Plans developed for individual waters or species. These documents emphasize development of specific management actions and direction to manage important sport fisheries under a framework of management emphasis as trophy waters, general and urban fisheries, or other categories defined by fishery potential and public demand and desires. Of particular importance in Nevada is the integration of planning for native endemic and non-native sport fish resources. Historic ignorance of the potential conflicts between these resources has significantly and negatively impacted Nevada's endemic sport and non-game fishes. Current fisheries management planning processes insure that potential conflicts will be minimized and allow more effective management of sport fish resources in companion with the aggressive implementation of essential conservation actions for endemic fish species.

Amphibians

Although interest exists for amphibian species at the continental and regional level through efforts such as the Amphibian Population Task Force and Partners in Amphibian and Reptile Conservation (PARC), these groups serve primarily as a coordination and information-sharing resource rather than as a mechanism to set guidance for conservation actions and objectives. Some Nevada amphibian species have regional distributions which extend beyond our borders, but much like endemic fishes, amphibian conservation efforts in Nevada are largely focused on a local level directed by the isolated distribution of their habitats and the corresponding spatial focus of conservation efforts on individual amphibian population centers. The primary tool used to date to direct and consolidate these efforts has been the development of the Conservation Agreement and Strategy (CAS), with four individual CAS documents in place directing individual partner working group conservation efforts for

Columbia spotted frog, Amargosa toad, and the relict leopard frog. Other endemic amphibian species in Nevada have received minimal attention for conservation planning with limited conservation efforts focused primarily on developing better baseline information on distribution and occurence. To the extent that planning needs for additional amphibian species are not addressed in key habitat conservation strategies in this document, identification and implementation of a conservation planning structure for them will be developed as part of WAP phase II design and implementation.

Setting Conservation Objectives

The four CAS documents for Columbia spotted frog, Amargosa toad and relict leopard frog were developed through a partnership process and define conservation objectives and strategy approaches for those species in substantial detail and those guidance documents are reviewed periodically by the respective conservation working groups to adaptively update and modify conservation approaches. Other amphibian species in Nevada do not have similar guidance available other than detailed generically at the key habitat level through this process, and development of appropriate conservation objectives for them will be an important component of our WAP phase II process, including completion of a more detailed Native Aquatic Species Plan, and establishment of a northern leopard frog working group and conservation plan.

Project Development and Implementation

Specific conservation actions are identified in the existing CAS documents for included amphibian species, with collaborative work group processes established to direct implementation. Those CAS strategies are relatively recent in development and are undergoing periodic, annual review to determine the need to modify or develop new projects for specific species programs and substantial updating and renewal of the agreements and strategies for Columbia spotted frog and Amargosa toad are anticipated to occur by 2013. For other amphibian species of concern, little effort has occurred to develop specific projects or implementation strategies to effect conservation, primarily because of the absence of active conservation processes which include them at a species-specific level. Developing that baseline information and identifying and prioritizing conservation needs at an action level for other conservation need amphibian species will be an important output direction from the Nevada WAP, the Native Aquatic Species Plan (in development) and the projected northern leopard frog working group and conservation plan.

Monitoring, Adaptive Management and Partners

Structured monitoring programs are in place for those amphibian species included in CASs, but with the exception of a few northern leopard frog and western toad populations are limited for other amphibian species to incidental and occasional efforts. Accordingly, significant gaps exist in distribution and status information which makes adequate assessment of conservation status for those amphibians difficult. Addressing those information needs will need to be an important focus of future efforts. Existing conservation efforts include a strong adaptive management component with periodic review of conservation efforts and efficacy, but this will need to be included as a component for other species through the development of more structured conservation programs. Significant partnerships already exist for those species included in the CAS implementation processes, including federal and local government partners. Structured monitoring programs for other amphibian species will be addressed during development of the northern leopard frog conservation plan and in the Native Aquatics Species Plan, but implementation of these activities will be dependent on funding availability.

Aquatic Gastropods

Setting Conservation Objectives

The aquatic gastropods have the most complete distribution information of all the aquatic priority conservation species; though only a fraction of potential habitats have been surveyed. The majority of the gastropods of conservation priority are located on BLM lands. Conservation objectives for those species are defined in A Guide to Managing, Restoring, and Conserving Springs in the Western United States; U.S. Dept. of the Interior, BLM Technical Reference 1737-17.

Project Development and Implementation

Completion of the Nevada Springs Conservation Plan (2011) was an important first step in compiling available information on the status and condition of Nevada's springs, many of which support important gastropod populations and habitats. However, the Plan is focused largely on state-wide goals and objectives and only identifies more detailed conservation needs and opportunities for a limited subset of significant spring landscape focus areas. Conceptual approaches in the 2011 Plan apply equally to the many important isolated springs in Nevada which support gastropods and aquatic biodiversity across Nevada's landscape, and an important next step will be establishment of a focused working group to contribute expertise, pool data, set objectives and priorities for site-based conservation actions and develop and implement more detailed management planning for the many Nevada springs not already addressed under the Nevada Springs Conservation Plan and other existing management plans.

Because many key springs are in a degraded condition, one of the key objectives will be to restore degraded springs and associated riparian areas, identify factors affecting site potential and adjust land uses to allow for natural spring and springbrook recovery.

Monitoring, Adaptive Management and Partnerships

These issues will be addressed once a working group is established; an implementation schedule will be developed, including monitoring progress and adapting management as needed. Partners should include at a minimum BLM (the principal land manager of aquatic gastropod habitat), academic gastropod experts, NDOW, and the USFS, another significant land manager of gastropod habitats.

Bivalves

Setting Conservation Objectives

Less than a dozen records are readily available for native freshwater mussel distribution, although anecdotal and historic records indicate that approximately 6 species occur or have occurred in Nevada. The California floater has a Nevada Natural Heritage Program state ranking of Critically Imperiled and is ranked from Vulnerable to Critically Imperiled throughout its range. It is dependent on fish during an important phase in its life history, and its fate is therefore linked with that of fish and fish habitats. No targeted surveys have been documented for freshwater mussels in Nevada. Conservation objectives will be detailed in the Native Aquatics Species Plan, but the main initial objective is to better determine current distribution.

Project Development and Implementation

Conservation strategies identified for key habitats and for fish that share these habitats are the main emphasis for bivalve conservation given available funding. Other bivalve projects will be designed to improve bivalve sighting information and fish host data. The Northwest Freshwater Working Group is developing plans, educational programs, and other conservation strategies for freshwater mussels, including the six putative

Nevada bivalve species. These tools will be used for bivalve conservation project development and implementation in Nevada where possible.

Monitoring, Adaptive Management and Partnerships
Monitoring of the effectiveness of efforts to increase knowledge of bivalve species distribution will be measured through annual assessments of documented records. This feedback will allow for better assessment of conservation status and potential need for intensified conservation planning.

Existing partnerships for bivalve conservation actions are the Northwest Freshwater Working Group. Other potential partners would include land management agencies, other governmental entities, and the general public (through outreach and reporting strategies). Many of the current partnerships for other aquatic species could be extended to include bivalves.

Crustacea

Nevada crustacea can be broken into three major taxa: the classes Malacostraca (crayfish, amphipods, scuds, etc.), Ostracoda (ostracods), and Branchiopoda (fairy, clam, and tadpole shrimp). Most crayfish species found in Nevada are non-native.

Setting Conservation Objectives
No crustacea are currently on the Aquatic Species of Conservation Priority list, and there is little information readily available about native crustacea. The first step therefore will be to learn more about what species occur in Nevada and their distribution so that their conservation status can be evaluated.

Project Development and Implementation
Species experts and potential partners will be determined in large part through literature searches and networking (listserves, etc.). Some experts have already been identified through these processes, and they will be consulted to assist with providing life history information and developing a list of conservation concerns.

Monitoring, Adaptive Management and Partnerships
Partnerships will be developed as described above, and monitoring and adaptive management strategies may be developed once conservation status is clarified.

Shellfish

Little documentation or planning currently exists for most native shellfish species in Nevada, with the exception of native aquatic gastropods.

Performance Indicators

With key support from the University of Nevada, Reno Biology Department, Nevada Department of Wildlife participated as a “demonstration state” in a project aimed at developing a framework for selecting key “performance indicators and measures” to monitor the effectiveness of conservation actions emanating from the State Wildlife Action Plans. The project was developed by a science team convened by the H. John Heinz III Center for Science, Economics, and Environment and Nevada was brought in as a demonstration state through the participation and recommendation of Science Team member Dr. Dennis Murphy of UNR. A workshop was convened in March 2008 to address three major topics:

1. the selection of targets for management and monitoring
2. the identification of threats, opportunities, and desired conditions for targets
3. development of conceptual models for each target

Participants in the first workshop were invited from the ranks of wildlife/habitat program leaders from federal and state natural resource management agencies. After process instruction from the Heinz Team, the working group selected three targets: 1) sagebrush; 2) Mojave shrub; and 3) riparian/springs. Breakout groups then built conceptual models for each of the targets incorporating what they knew about key stressors associated with the target and opportunities to take action.

A second team of sagebrush ecologists was convened in August 2008 with the task of actually selecting performance indicators for sagebrush habitats and building a draft monitoring protocol for measuring sagebrush performance statewide. By the end of the second meeting held December 4, the team had selected a list of sagebrush wildlife species best thought to reflect various trends in sagebrush habitat health and was working on a draft multi-taxa monitoring protocol based on a presence/absence statistical model led by Dr. James Sedinger of UNR's Natural Resources and Environmental Science Department.

Performance indicators for riparian/springs were selected as part of a multi-partner Springs Conservation planning effort headed by the Nevada Natural Heritage Program in collaboration with The Nature Conservancy's Northern Nevada Office funded by a Question One Bond Planning Grant. The performance indicators team for the Mojave shrub target was first convened in October 2010.

Sagebrush Technical Advisory Team

In 2010, The Sagebrush Technical Advisory Team for Nevada's Wildlife Action Plan (STAT) developed an experimental sagebrush wildlife and vegetation sampling framework to monitor and assess the effects of applied management and climate change on the sagebrush ecosystem and the wildlife that sagebrush supports in Nevada.

The Bureau of Land Management, through a generous grant from its Washington, DC office, made funding available to put the first phase of project implementation into motion. A network of sample locations was selected at random from the Great Basin Bird Observatory Nevada Bird Count Network sagebrush sites. A team of two wildlife technicians implemented a small mammal trapping scheme along with visual reptile surveys and line-intercept shrub crown measurement at 38 selected sites. Two summers of data have been collected to date. Data analysis is conducted by the UNR Conservation Biology Department. Results are presented to the STAT for review and comment annually. Recommendations from the STAT will eventually flow to key sagebrush management decision bodies such as The Nevada Habitat Partnership to assist their planning and implementation decision-making processes.

Mojave Technical Advisory Team

The first meeting of a group of experts to build a performance monitoring framework for Mojave desert types was convened in Las Vegas October 2010. Scientists and land managers from NDOW, both the Las Vegas and Reno campuses of the University of Nevada, Audubon Important Areas Program, Bureau of Land Management, National Park Service, U.S. Geological Survey, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, The Nature Conservancy, and Nellis Air Force Base all attended. The group started with the Mojave conceptual model developed at the 2008 Heinz Center workshop, made a couple of adjustments to the model to fit their own perceptions, and developed a list of key habitat "targets" within the ecosystem. Key stressors were developed for each target, a short list of key species of conservation concern was derived from each target, as well as a key "indicator species" that could realistically be monitored given available survey techniques. On the second day, the group developed by consensus a "Desired Condition for Wildlife for the Mojave ecosystem -- Resilient wildlife communities representing the full complement of native and desired biodiversity on a landscape of connected mosaics of protected and managed natural habitats." The group then explored possible performance monitoring frameworks after a presentation of the model developed by the Sagebrush Technical Advisory Team. An inventory of ongoing monitoring efforts by workshop participants as well as everything outside the group known in the Mojave ecosystem was then gathered as the last item before the meeting was adjourned. Follow-up of this very productive first meeting is expected to occur in the near future.

Springs/Riparian Performance Indicators

The WAP Phase II Team discussed the possibilities of starting a technical discussion for the third Heinz Center workshop target for WAP Performance Indicator development, Springs/Riparian, but progress toward pulling a group together seemed to be hindered by the delayed completion of the Springs/Springbrooks Report, a conservation assessment funded with Nevada Question One Conservation Bond money. This advisory committee will be convened in the near future.

Performance Indicators Summary

It is the intent of the Wildlife Action Plan Team that these three advisory committees develop roles in guiding Phase IV implementation of this WAP Revision. A task of Phase IV will be to put the conservation strategy sections of the Revision to the test to see if other conservation targets may benefit from the collaborative action of expert technical groups. New targets could be habitat-based as are the current three, or they could be species-based (such as the Governor's Sage Grouse Conservation Team) or species-group-based (e.g. Partners In Flight, Nevada Bat Working Group, etc.).

Monitoring strategies for SOCP are well-documented in the Nevada WAP. As the state agency with expertise and legislative authority for Nevada's wildlife, NDOW has the ability to undertake and accomplish many of the monitoring strategies for species listed in the plan. Comprehensive monitoring strategies for the 22 key habitats are not as well defined in the plan. Some references to habitat monitoring are found within individual conservation actions but are not as comprehensive as those provided for species. Although NDOW does currently conduct and will continue to conduct monitoring of habitats, often to monitor the success of habitat restoration projects, the BLM and other land management agencies are the lead for most habitat monitoring activities. NDOW and the Wildlife Action Plan Team will continue to work closely with federal land management agency partners to fulfill the habitat monitoring needs of key habitats during the implementation of this plan. This may include developing new habitat-based conservation targets (e.g. Aspen Woodlands), through the collaboration of expert technical groups.

WAP Revision

The proceeding implementation and integration strategies make clear that much of the adaptive management analysis will occur by integrating the WAP into existing plans. The WAP itself will be updated and adjusted according to results, changing issues and conditions and increased knowledge from implementation and research. The Nevada WAP is designed to be a 10-year plan, so complete evaluation and revision is scheduled to occur on a 10-year rotation. Because issues and conditions can change so quickly in natural resources management, the Wildlife Action Plan Team will work with the greater Nevada wildlife conservation partnership to keep the plan current and on-track.

Tracking of Conservation Actions

NDOW will be using the USFWS tool "*Wildlife Tracking and Reporting on Actions for Conservation of Species (TRACS)",* during the implementation of this plan to report progress to the Wildlife and Sport Fish Restoration Program. We will also be using the AFWA and USFWS document: *"Measuring the Effectiveness of State Wildlife Grants Final Report"* as guidance during the implementation of this revised plan.

CONSERVATION EDUCATION AND WATCHABLE WILDLIFE

In terms of human population, Nevada was one of the fastest growing states in the nation for much of the last decade, with 3 of its most populous cities in the top 20 nationwide for growth. Though much of that growth has tapered off, it created an attendant loss of wildlife habitat, environmental contamination, and introductions of exotic species. Residents must be educated about the necessity of protecting habitat and one of the state's most important natural resources, its wildlife. Our residents, both native and new, need additional information to be able to better understand the complex issues that fish and wildlife face in this day of increased urbanization and decreased habitat.

In order to meet the needs of the public, three wide-ranging approaches must be developed and funded in Nevada: a statewide Kindergarten-12th grade Wildlife Education curriculum for use in the schools; a statewide Watchable Wildlife program that provides opportunities for urban dwellers to enjoy interpretive wildlife trails in a natural area near their metropolitan center; and a proactive outreach program that informs the public about sensitive and threatened species and the ecosystems in which they live.

Setting Conservation Objectives

Some Conservation Education actions for the WAP are already identified within the Key Habitat Conservation Strategies described previously in this plan. Priorities for these actions will be determined by the WAP Implementation Team. These actions will be incorporated into the biennial and annual work programs of NDOW's Conservation Education Division. The Conservation Education Division will work in partnership with counties, local governments, tribal governments, non-profit groups, and state and federal resource partners to support these communication actions. In addition, these objectives will be communicated within a variety of interagency planning processes, including ongoing USFWS, USFS, and BLM planning processes. In addition to the Conservation Education actions described in this plan, NDOW's Conservation Education Division in December 2011 initiated a new strategic direction for the agency's Wildlife Education program.

This program plan, which is being developed with input from the public, stakeholders, and various partners, sets goals, objectives and actions for the agency's Wildlife Education program. On parallel, the Conservation Education Division's Strategic Plan is being revised to update existing goals, objectives and strategies in line with the agency's all-encompassing Comprehensive Strategic Plan. Both of these planning elements provide opportunities for enhanced outreach and education about the Species of Conservation Priority.

In particular, the Wildlife Education plan will develop the strategies and actions necessary to implement the WAP Education Objectives identified in this plan. The Conservation Education Division Strategic Plan will develop the strategies and actions necessary to implement WAP Outreach Objectives identified in this plan. The Outreach, Watchable Wildlife, and Wildlife Education Objectives are described below.

WAP Outreach Objectives

Nevada's population growth both strains its natural resources and creates the need for outreach. According to the 2010 U.S. Census Bureau data, Clark County, the state's largest county, added 575,504 of Nevada's 702,294 new residents -- accounting for four out of every five new residents. Nearly half of those new residents were Hispanics, who now make up 27% of the state's population, up from 20% a decade earlier.

Most of the state's other counties added more people, as well. Washoe County, home to Reno and Sparks, grew by 24%. Nye County, 60 miles west of Las Vegas, grew 35%. The fastest-growing county was Lyon County, home to the Fernley, which took home the title of fastest-growing city in Nevada. Lyon County grew 51%.

New approaches are necessary to communicate with these new audiences and inform them about the challenges facing wildlife and wildlife habitat in their home state.
Benefits of outreach include:

- Increase in broad-based support for conservation efforts
- Increase in support for public funding mechanisms (including tourism)
- Increased understanding of urgent conservation and human impact issues
- Changes in behavior to preclude negative impacts to wildlife and wildlife habitat

A successfully implemented public outreach program will engender recognition of the value of wildlife as an important quality of life component, enhance public understanding of the interconnectedness of wildlife and the ecosystems upon which they rely, and engender support for wildlife and the programs that support wildlife.
Communications strategies depend upon the outreach need, and would include targeted outreach to key groups, mass-media outreach through print, television, and radio, and a new push through online and social media channels, among others. The following WAP Outreach Objectives would be addressed:

Habitat Loss/Destruction

Urbanization, population growth, and increased use of Nevada's outdoors put the entire state at risk for habitat loss. As the suburbs expand outward in the northern part of the state, mule deer and black bear habitat has been converted to suburban neighborhoods with highway corridors, and schools. OHV trails in the Duck Creek Basin alone, near Ely, in Eastern Nevada, has increased 65% since 1977, with more than 225 km (140 miles) of new routes in that one area. (J. Worley, BLM, pers. comm.) Species such as deer, elk, antelope and sage grouse in particular are affected.

In Las Vegas Valley, suburbs and a burgeoning human population create extensive networks of roads across sensitive desert habitats. Fragile sand dunes, and unique desert hot springs home to endemic fishes and aquatic species found nowhere else in the world, are threatened by development, agricultural uses, and other human activity.

Communications to increase understanding of these issues will help gain public support for changes in behavior, and may facilitate increased understanding of wildlife needs as part of local government planning efforts. The identified outreach goals will be:

- Increased public knowledge of the impacts specific activities have upon wildlife and wildlife habitat
- Change behavior to alter OHV use in sensitive areas
- Increased monitoring and input into local government planning processes to support planning for wildlife.

Climate Change

Climate change is emerging as a major stressor to habitats and species across Nevada and conservation planning and public education and outreach efforts need to take this into consideration. Climate change is often not well understood by general audiences, therefore creating difficulty in gaining support to combat the effects of climate change. A dedicated effort will be made to engage the public and key stakeholders to educate them about what climate change actually is and how it impacts wildlife will be the first step toward cooperative efforts to combat the effects of climate change.

Aquatic Invasive Species

With the passage of AB167 in the 2011 Legislative Session, the Nevada Department of Wildlife (NDOW) will develop a coordinated statewide aquatic invasive species (AIS) management plan to control and prevent species like quagga mussels, Didymo (rock snot), Asian clams, curly leaf pondweed, northern pike and many others.

Several important bodies of water in the state are already infested with harmful aquatic invasive species. Lake Mead in southern Nevada is invested with quagga mussels and two other reservoirs are considered suspect.

Communications to increase understanding of invasive species issues will help gain public support for changes in behavior to prevent spread and new introduction of AIS. The identified outreach goals will be:

- Educate boaters to clean, drain and dry boats between every use
- Inform anglers about the practice of clean angling
- Increase outreach to the public regarding releasing of non-native species

Sensitive Species

Nevada ranks third highest nationwide in the percentage of species at risk, with the fourth highest percentage of fish and third highest percentage of amphibians at risk. Clark County, home to 70 percent of Nevada’s population ranks second in the nation among U.S. metropolitan counties in number of species imperiled by development. Many residents are completely unaware of the number of sensitive species and lack knowledge in what can be done for these species. More educational programs to familiarize the public with the value of wildlife on the list of species of conservation priority are sorely needed. As people learn more about the life history and habitat needs of these sensitive species, they’ll be more prepared, and more likely to get involved in decisions affecting those species. People need to know the consequences of extinction and what they can do to help prevent it. The following sensitive species and ecosystem issues will be addressed in some detail in the outreach programs:

<u>Endemic Fishes</u>

- Increase public knowledge of species life history
- Increase understanding of how human impacts, from recreation, habitat fragmentation, urbanization, and dewatering affect endemic fishes

- Increase understanding of how exotic competitors, such as mosquito fish, guppies, mollies, and cichlids affect native habitats and species.

Mollusks and other Aquatic Species
- Invite volunteers and public to provide input on mollusk and amphibian population management
- Increase awareness of aquatic nuisance species and their impacts on state waters
- Increase awareness of issues related to releasing pets to the wild and problems with exotic releases

Bats
- Increase understanding and appreciation of bats
- Increase understanding of the importance of mines and caves for bat species
- Build partnerships to support bats and bat conservation in the state
- Support bat education in the schools with video and brochure

Mesquite Bosques
- Increase understanding of the value of the mesquite-catclaw environment for wildlife

Sagebrush
- Increase public understanding of the value and importance of sagebrush ecosystems of the

Wetlands, Playas, and Springs
- Increase public understanding of the value and importance of wetlands, playas, and springs in Nevada.

WAP Wildlife Education Objectives

Long–range wildlife education will consist of a comprehensive K-12 public school curriculum designed to form attitudes of responsible wildlife resource stewardship. This effort must start in the primary years with continual reinforcement at each grade level. Currently there are no state statutes or funding mechanisms in place to support conservation education. An appropriate education program must be designed and aligned with the Nevada State curriculum standards, with emphasis on usability for the classroom teacher. The curriculum materials must be constructed so that teachers view it as a tool to help them meet their identified district and state standards rather than another requirement to fit into their day. The goals of this Wildlife Education program are:

- Develop life-long interest in state wildlife, and interest in stewardship ethic
- Increase student understanding of the states' wildlife species and the ecosystem where they live
- Provide opportunities for student use of hands-on wildlife kits that support the scientific method of inquiry
- Produce public school graduates prepared to understand issues and make responsible science-based wildlife management decisions

Watchable Wildlife WAP Objectives

A Watchable Wildlife program is a crucial element in the Nevada Department of Wildlife's efforts to inform the people of Nevada about their wildlife resources and, in turn, build support for its conservation. Over 91% of Nevada residents live in urban areas, much of Nevada's population is unaware of the area's wildlife, ways to enjoy it, and the impacts they have on it. Therefore, there is a need to offer opportunities for viewing and learning about Nevada's natural wildlife resources. A fully equipped Watchable Wildlife program would enable the public to facilitate their own learning at interpretive trails and information kiosks and viewing platforms. In this way, NDOW could offer additional opportunities to view and enjoy wildlife in both rural and urban environments.

Currently, NDOW is affiliated with several facilities near urban areas throughout the state including the Oxbow Nature Study Area, Verdi Wildlife Education Center and Washoe Lake Wetlands, which provide information through the use of kiosks in a natural setting. Kiosks are also being planned and developed for seven Wildlife Management Areas across the state. Wildlife viewing festivals are currently held in the City of Fallon (Spring Wings Bird Watching Festival) and with the City of Hawthorne's annual Loon Tour. In addition, the agency has supported the development of a statewide birding map with the Lahontan Audubon Society.

Opportunities to expand the state's watchable wildlife program could be entered into with partners at the federal, state, county and city level. Signage, kiosks, seminars, and clinics in these areas would provide increased information and education to the public on wildlife-related issues, techniques for viewing wildlife, feeding birds, and landscaping to encourage or discourage wildlife visitors. These components would be promoted using newspaper articles, radio, and print media.

Ultimately, economic benefits to the state from watchable wildlife could be tremendous. According to the 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, over $866 million is spent each year in Nevada on wildlife related recreation, of that, $415 million comes from non-consumptive recreational activities, indicating a real interest in watchable wildlife. A Watchable Wildlife program would prove beneficial in the following ways:

- Increase in broad-based support for conservation efforts
- Increase in support for public funding mechanisms (including tourism)
- Increased understanding of urgent conservation and human impact issues

Implementation

Implementation of the Conservation Education actions for a statewide Watchable Wildlife, comprehensive Kindergarten-12 Wildlife Education program, and outreach efforts for the identified Conservation Strategies will be effected by NDOW and resource partners across the state. A number of resource agencies already work cooperatively on planning efforts, such as the Cooperative Resource Management subcommittee on information (Nevada Resource Outreach Network). This group meets monthly to share information about resource activities around the state and develop communications strategies on key issues. Most recently, sage grouse have risen as a key issue, and the group is currently focused on developing a statewide sage grouse communications strategy in support of the Governor's Sage Grouse Team implementation efforts. In the past, members of the Cooperative Resource Management Public Information Officers group have developed Leave No Trace outreach materials. In the future, there will be additional emphasis on proper and ethical use of OHVs. This is one of the key outreach objectives in the WAP, and can be met through this collaborative communications partnership.

Partners and collaborative communications efforts are essential if conservation planning is to be effective. To date state and federal agencies in the state have provided good information and communications on joint efforts, in particular, BLM, USFWS, USFS, and the Natural Resource Conservation Service.

Effectiveness Monitoring

Public surveys through NDOW's Comprehensive Strategic Planning Process, which occurs every five years, and through regional survey approaches, such as the Western Association of Fish and Wildlife Association's recent survey on public attitudes (see Teel and Dayer 2005) will be used to identify whether key communications goals are being met. In addition, online survey mechanism, focus group surveys via telephone and print, and regional focus groups, will be applied to identify that outreach, education and watchable wildlife goals and objectives are being met.

LIST OF ABBREVIATIONS AND ACRONYMS

ACEC: Area of Critical Environmental Concern
AGFD: Arizona Game and Fish Department
ALC: American Land Conservancy
AIS: Aquatic Invasive Species
ANS: Aquatic Nuisance Species
AOU: American Ornithological Union
APHIS: Animal and Plant Health Inspection Service
ASU: Arizona State University
ATCAS: Amargosa Toad Conservation Agreement/Strategy
ATWG: Amargosa Toad Working Group

BBS: Breeding Bird Survey
BLM: Bureau of Land Management
BOR: Bureau of Reclamation
BRD: Biological Research Division
BSS: Big Spring Spinedace

CARA: Conservation and Reinvestment Act
CBC: Christmas Bird Counts
CCAA: Candidate Conservation Agreement with Assurances
CCVI: Climate Change Vulnerability Index
COE: Corp of Engineers
CR: Colorado River
CRM: Coordinated Resource Management
CSC: Climate Science Center
CSP: Conservation Security Program

DAPTF CA/NV: Declining Amphibian Population Task Force, California/Nevada Chapter
DCP: Desert Conservation Program
DFC: Desert Fishes Council
DLCC: Desert Landscape Conservation Cooperative
DOD/DOI: Department of Defense/Department of the Interior
DOE: Department of Energy
DPS: Distinct Population Segment
DRI: Desert Research Institute
DU: Ducks Unlimited

EDRR: Early Detection, Rapid Response
ENLC: Eastern Nevada Landscape Coalition
EQIP: Environmental Quality Incentives Program
ESA: Endangered Species Act
EWRA: Emergency Wetlands Resources Act

GAP: Gap Analysis Program

GBBO: Great Basin Bird Observatory
GBEP: Great Basin Environmental Program
GBLCC: Great Basin Landscape Conservation Cooperative
GBLW: Great Basin Land and Water
GHABCOM: Global Habitat Comments
GIS: Global Information System

HCP: Habitat Conservation Plan
HWI: Hawk Watch International

IBA: Important Bird Area
IUCN: The International Union for the Conservation of Nature & Natural Resources (World Conservation Union)
IWJV: Intermountain West Joint Venture

LCC: Landscape Conservation Cooperative
LCRMSCP: Lower Colorado River Multi-species Conservation Plan
LMB: Largemouth Bass
LTBMU: Lake Tahoe Basin Management Unit

MDEI: Mojave Desert Ecosystem Initiative
MDF: Mule Deer Foundation
MRREIAC: Muddy River Regional Environmental Impact Alleviation Committee
MSCP: Multiple Species Conservation Plan
MSHCP: Multiple Species Habitat Conservation Plan

NACO: Nevada Association of Counties
NAS: Naval Air Station
NBI: Nevada Biodiversity Initiative
NBU: Nevada Bighorns Unlimited
NDCD: Nevada Division of Conservation Districts
NDEP: Nevada Department of Environmental Protection
NDOA: Nevada Department of Agriculture
NDOM: Nevada Division of Minerals
NDOW: Nevada Department of Wildlife
NDSL: Nevada Division of State Lands
NDSP: Nevada Division of State Parks
NEPA: National Environmental Protection Act
NESF: Northeastern Subpopulation Spotted Frog
NESFCAS: Northeastern Subpopulation Spotted Frog Conservation Agreement/Strategy
NESFTT: Northeastern Subpopulation Spotted Frog Technical Team
NFH: National Fish Hatchery
NFHTC: National Fish Hatchery and Technology Center
NFWG: Native Fish Work Group
NGO: Non-Governmental Organization
NNHP: Nevada Natural Heritage Program
NPS: National Park Service
NPCD: Nevada Partners in Conservation & Development
NRA: National Recreation Area

NRCS: Natural Resource Conservation Service
NSC: Nevada Sportsman Coalition
NTS: Nevada Test Site
NVSCP: Nevada Springs Conservation Plan
NVWP: Nevada Wetlands Priority Conservation Plan
NWFMWG: Northwest Fresh Mussel Working Group
NWR: National Wildlife Refuge

OHV: Off-Highway Vehicle
ORV: Off-Road Vehicle

PARC: Partners in Amphibian and Reptile Conservation
PARC A & RHMG: Partners in Amphibian & Reptile Conservation Amphibian and Reptile Habitat Mgmt Guidelines
PCD: Partners in Conservation & Development
PIF: Partners in Flight

Q1: Question 1 Conservation Bond and Resource Protection Grant Program

REA: Rapid Ecological Assessment
RIT: Recovery Implementation Team
RLF CAS: Relict Leopard Frog Conservation Agreement/Strategy
RLFCT: Relict Leopard Frog Conservation Team
RMEF: Rocky Mountain Elk Foundation
RMP: Resource Management Plan
RT: Recovery Team

SHA: Safe Harbor Agreement
SMP: Species Management Plan
SNWA: Southern Nevada Water Authority
SWG: State Wildlife Grant
SW PARC: Southwest Chapter of Partners in Amphibian and Reptile Conservation
SWReGAP: Southwest Regap

TMWA: Truckee Meadows Water Authority
TNC: The Nature Conservancy
TPL: Trust for Public Land
TRPA: Tahoe Regional Planning Agency
TSF CAS: Toiyabe Subpopulation Spotted Frog Conservation Agreement/Strategy
TSFTT: Toiyabe Subpopulation Spotted Frog Technical Team
TU: Trout Unlimited
TWG: Tribal Wildlife Grant

UDWR: Utah Division of Wildlife Resources
UNR: University of Nevada, Reno
UNLV: University of Nevada, Las Vegas
UPCD: Utah Partners for Conservation & Development

USBoR: United States Bureau of Reclamation
USDA: United States Department of Agriculture
USFS: United States Forest Service
USFWS: United States Fish and Wildlife Service
USGS: United States Geological Survey
USGS-BRD: United States Geological Survey, Biological Resources Division

VR: Virgin River
VRRMRP: Virgin River Resource Management and Recovery Program

WAP: Wildlife Action Plan
WGA: Western Governor's Association
WHIN: Wildlife and Habitat Improvement of Nevada
WHIP: Wildlife Habitat Incentives Program
WMA: Wildlife Management Area (Nevada Department of Wildlife)
WRP: Wetlands Reserve Program

YCT: Yellowstone Cutthroat Trout

GLOSSARY

alluvial fan: A deposit of rocks, sand, gravel, and finer materials that has been laid down by water as it flows from a mountainous area on to a plain.

AOU (American Ornithologists' Union): The oldest and largest organization in the New World devoted to the scientific study of birds. The recognized arbiter of lumping, splitting, and naming of bird species in North America.

biogeography: The study of the geographical distributions of organisms, their habitats and the historical and biological factors which produced them.

commensalism: a mutually beneficial relationship between organisms of different species.

edaphic: Influenced by the nature of the soil.

endemic: Native to, and restricted to, particular geographical region.

habitat suitability model: a description of physical factors, often quantified numerically, that describe the habitat preferred by a species.

halophytic: tolerant of saline conditions.

hibernaculum: a shelter occupied during the winter by a dormant animal. Plural: hibernacula.

lentic: pertaining to static or slow moving open water.

lotic: pertaining to fast-moving water habitats, such as streams and rivers.

mesic: characterized by the presence of moderate water.

orographic: pertaining to relief factors such as hills, mountains, plateaux, valleys and slopes.

seral: of, relating to, or constituting an ecological sere (a series of ecological communities formed in ecological succession).

stochasticity: referring to patterns resulting from random factors.

subnivean: the zone in or under snowpack or occurring under the snowpack.

urostyle: a spikelike bone, a downward extension of the vertebral column. Its presence is evidence that primitive frogs probably had tails.

xeric: characterized by aridity.

xerophytic: tolerant of arid conditions.

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SPECIES ACCOUNTS

KEY CODES & DESCRIPTIONS

This chapter contains an overview of the distribution, life history, and management concerns for each of the Nevada WAP Species of Conservation Priority (SOCP). For the most part, the information provided here is Nevada-centric and does not consider life history needs or management concerns that are more germane to species' populations outside of our borders. In a few cases, no published literature specific to a species in Nevada could be found, and so information generated in adjacent states and populations was used, and in these cases the reader will see references to Oregon, California, Utah, and other states. But, wherever possible, an attempt was made to adapt findings from outside the state appropriately into a Nevada context.

All accounts are presented in alphabetical order by common name (within each taxonomic group); the common name and the scientific name are in bold type at the top of the first page of each account. Taxonomy follows Hershler (1998 and 1999) for mollusks, the American Fisheries Society (2004) for fishes, Frost (2010) for amphibians, Crother (2012) for reptiles, the AOU (1998) for birds, and Mantooth and Riddle (2005) for mammals.

Rationale for inclusion as a WAP SOCP is provided at the top of the species account, as well as a map illustrating the distribution of the species in the state (for birds, winter range is depicted in blue and breeding range in orange as seen in Figure 1). To create the distribution maps, NDOW downloaded species range data from the USGS GAP (http://gapanalysis.usgs.gov/species/). These ranges were based upon known species occurrences provided by NatureServe overlain with 12-digit hydrologic units (HUCs). Species range layers were then individually evaluated by the NDOW Wildlife Diversity Staff Specialist and other staff for accuracy using NDOW occurrence data and expert knowledge of the species presence on the landscape. Adjustments to the GAP species ranges were made by selecting individual HUCs to be either included or excluded based upon the expert review. For some species it was determined that HUCs were poorly suited to represent species true range. In these cases mountain ranges and basins were delineated to better represent the species ranges when applicable. Finally, for the species not mapped by the GAP, NDOW staff created species ranges using the GAP methodology described above.

Figure 28. Key for distribution of species ranges within species account maps.

The *Agency Status* section provides the species' status according to various federal and state agencies and non-governmental organizations and only lists the organization if the species had status within that organization. A key to agency acronyms and the definitions of various statuses are provided at the end of this introductory material. The *Trend* section identifies the abundance of the species in the state and the trajectory of the population, if known. When available, bird population estimates are provided in the Trend section of the species account. The source and the confidence in the quality of the population estimate are provided in parentheses after the estimate (e.g., NDOW, moderate). These estimates (originally provided in the Nevada Comprehensive Bird Conservation Plan) were derived from a number of sources including expert opinion (expert), U.S. Fish and Wildlife Service (USFWS), Nevada Bird Count (NBC), Nevada Department of Wildlife (NDOW), Partners in Flight (PIF), and the Breeding Bird Survey (BBS). Confidence is provided as low, moderate, or high and was obtained from the Nevada Comprehensive Bird Conservation Plan (GBBO 2010) or based on NDOW data. The *Distribution* identifies the location of the species and focuses on its distribution within the state of Nevada. The *General Habitat and Life History* section provides general information about the species and its habitats and habits. Note that this section does not provide comprehensive information but rather attempts to report on information that is crucial to its conservation or provides the reader with context to the basic biological needs of the species. The *Conservation Challenges* section discusses the current threats and issues that affect the species and, in some cases, its associated habitat(s). The *Needs* section highlights the research, monitoring, and approach for conservation strategies and/or actions.

The information provided here was gathered from many different sources, including the Nevada Natural Heritage Program, NatureServe Explorer (2012), The Nevada Comprehensive Bird Conservation Plan (GBBO 2010), in addition to the references cited at the end of this section. Where citations were included in NatureServe's accounts they are also incorporated here and relevant reference material listed at the end of this appendix. Appropriate citations (separate from the preceding WAP chapters) are included for any additional reference materials that were consulted to compile this chapter.

Key to Agency Status Section

Nevada Natural Heritage Program (NV Natural Heritage) Conservation Status Ranks

The Nevada Natural Heritage Program (NNHP) ranks species based upon rarity and trend, using a number of different factors. NNHP is a member program of NatureServe, a non-profit conservation organization whose mission is to provide the scientific basis for effective conservation action. NatureServe represents an international network of heritage programs that operate in all 50 U.S. states, Canada, Latin America, and the Caribbean. The 81 member organizations of the NatureServe network collect and analyze data about the plants, animals, and ecological communities of the Western Hemisphere. NNHP maintains information on the precise locations and conditions of at-risk species and threatened ecosystems throughout the state, and compiles and disseminates that information to our conservation partners, state and federal agencies, and the public. Through regular data exchanges with member programs, NatureServe provides the same service on a regional and national level. NatureServe and all member heritage programs and conservation data centers use the same rigorous scientific methodology to ensure that data are accurate and of the highest quality possible.

NatureServe and NNHP use a suite of factors to assess the extinction or extirpation risk of plants, animals, and ecosystems. Conservation status is assessed at multiple scales: globally (G-rank), nationally (N-rank; not reported in this appendix but available online at www.natureserve.org/explorer), and subnationally (S-rank; denotes state or province status). G-ranks are typically assigned by NatureServe. S-ranks by contrast, are assigned by individual state/provincial programs. Factors used in ranking a species include rarity, trend, and threats. Population size, number of occurrences, long- and short-term trend, threat impact, and the intrinsic vulnerability of a species are some of the factors used to assign a conservation rank. Additionally, subspecies or varieties can be ranked independently of their parent species. This rank is called an infraspecific taxon (trinomial) rank and is indicated by a T before the numerical rank.

At all scales, a rank from 1-5 is assigned to a taxon, with 1 indicating a taxon is critically imperiled and 5 indicating the taxon is widespread and common. The level of assignment is denoted by a G, S, or T before the number. For example, the California leaf-nosed bat (*Macrotus californicus*) has a G4S2 rank. This means that globally, California leaf-nosed bats are uncommon but not rare with some cause for long-term concern due to declines or other factors. However, in Nevada, as denoted by the S2 portion of the rank, California leaf-nosed bats are at high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

Qualifiers can be added to ranks to provide further information. For example, adding an N to a rank indicates the rank applies to a non-breeding population whereas a B denotes that the rank applies only to a breeding population. This methodology is generally applied to birds, which often have a winter (non-breeding) population and a breeding population that is distinctly separate. As an illustration, consider the Bald Eagle. Its current rank is G5S1B, S3N. This rank indicates that Bald Eagles are globally common and widespread (G5), critically imperiled in its breeding range in Nevada (S1B), and vulnerable in Nevada during the non-breeding season (S3N). Other qualifiers that can be added to a given rank denote taxonomic uncertainty (Q), rank uncertainty (?), conservation rank not yet assigned (NR), or conservation rank not applicable (NA; used to denote non-native taxa or in the case of birds, taxa that are accidental to the state).

Listed below are definitions for interpreting NatureServe and NNHP global (G-ranks), subnational (S-ranks; in this case for Nevada), and infraspecific (subspecies or variety; T-ranks) conservation status ranks.

Basic Rank	Definition
G, S, T **X**	**Presumed Extinct**—Not located despite intensive searches and virtually no likelihood of rediscovery.
G, S, T **H**	**Possibly Extinct**—Missing; known from only historical occurrences but still some hope of rediscovery.
G, S, T **1**	**Critically Imperiled**—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G, S, T **2**	**Imperiled**—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G, S, T	**Vulnerable**—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

3	
G, S, T 4	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G, S, T 5	**Secure**—Common; widespread and abundant.

Variant Rank	Definition
G#G# S#S# T#T#	**Range Rank**—A numeric range rank (e.g., G2G3) is used to indicate the range of uncertainty in the status of a species or community. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
G, S, T U	**Unrankable**—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.
G, S, T NR	**Unranked**—Rank not yet assessed.
G, S, T NA	**Not Applicable**—A conservation status rank is not applicable because the species is not a suitable target for conservation activities, for example, to denote an exotic species or because the species is accidental to the state.

Rank Qualifiers	Definition
?	**Inexact Numeric Rank**—Denotes inexact numeric rank (e.g., G2?)
Q	**Questionable taxonomy**—Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.

State Status Definitions—NNHP Climate Change Vulnerability Index (CCVI)

Climate change vulnerability assessments were conducted by NNHP for the Nevada SOCP using the NatureServe Climate Change Vulnerability Index (CCVI). The methods used for the vulnerability analysis are described in *Approach & Methods* chapter of this document. The CCVI uses a scoring system that integrates a species' predicted exposure (direct and indirect) to climate change within the assessment area (in this case, the state of Nevada) and a series of factors, all supported by published studies, associated with a species' sensitivity to changes in climate. The tool also incorporates documented or modeled response to climate change, if available. The tool weighs each sensitivity score depending on the magnitude of projected climate change, incorporates any documented or modeled responses, and calculates a final vulnerability index score. The final vulnerability scores are listed in the Agency Status box of each species account under CCVI. The scores include the following:

CCVI Score	Definition
EV	**Extremely Vulnerable**-Abundance and/or range extent within geographical area assessed extremely likely to substantially decrease or disappear by 2050
HV	**Highly Vulnerable**- Abundance and/or range extent within geographical area assessed likely to decrease significantly by 2050
MV	**Moderately Vulnerable**-Abundance and/or range extent within geographical area assessed likely to decrease by 2050
PS	**Not Vulnerable/Presumed Stable**-Available evidence does not suggest that abundance and/or range extent within the geographical area assessed will change (increase/decrease) substantially by 2050. Actual range boundaries may change
IL	**Not Vulnerable/Increase Likely**-Available evidence suggests that abundance and/or range extent within geographical area assessed is likely to increase by 2050.

U.S. Fish & Wildlife Service (USFWS) Categories for Listing under the Endangered Species Act (ESA)

Code	Status
LE	**Listed Endangered**-in danger of extinction in all or a significant portion of its range
LT	**Listed Threatened**-likely to be classified as endangered in the foreseeable future if present trends continue
PE	**Proposed Endangered**
PT	**Proposed Threatened**
(PS)	**Partial Status-** a subspecies or a portion of a taxon's range has listed or candidate status, but not in Nevada
C	**Candidate** for listing as threatened or endangered; sufficient data on vulnerability or threats on file, but listing precluded by other higher priority species.
XE	**Essential experimental** population
XN	**Nonessential experimental** population

No Status	**Not Listed** (no status) in a portion of the species' range

Bureau of Land Management (BLM) Species Classification

Code	Status
Sensitive	Nevada Special Status Species-ESA listed, proposed or candidate for listing, or protected by Nevada State Law
California Sensitive	BLM California Sensitive Species

United States Forest Service (USFS) Species Classification

The USFS status includes Region 4 (Intermountain), Region 5 (California), and the Lake Tahoe Basin Management Unit (LTBMU). The appropriate region is indicated in the Agency Status box as USFS-R4, USFS-R5, or USFS-Lake Tahoe Basin Management Unit, respectively.

State Protection Status as defined in Nevada Revised Statute (NRS) 501 and listed in the Nevada Administrative Code (NAC) chapter 503

Species provided protection under NRS 501 and listed in NAC 503 are protected under state law and are managed by the Nevada Department of Wildlife (NDOW). In some cases, species may not be harmed or subject to any "take;" in other cases, "take" is allowed but only with a license or permit. Under the statute, species may be classified as fur-bearing, game, upland game, migratory game, or protected (e.g., Protected Reptile NAC 503.080.1 or Game Mammal NAC 503.020). Protected species can also be further classified as sensitive, threatened, or endangered. If a species has statutory status, it is denoted as State Prot in the Agency Status box of the species account.

IUCN Red List Categories and Their Definitions (IUCN 2011).

The IUCN - The World Conservation Union, through its Species Survival Commission (SSC), has for four decades been assessing the conservation status of species, subspecies, varieties, and selected subpopulations on a global scale in order to highlight taxa threatened with extinction. The IUCN Red List of Threatened Species provides taxonomic, conservation status, and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction. IUCN Red List assessments are often carried out in conjunction with NatureServe in North America.

Code	Status
EX	A taxon is **Extinct** when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EW	A taxon is **Extinct in the Wild** when it is known only to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon’s life cycle and life form.
CR	A taxon is **Critically Endangered** when the best available evidence indicates that it meets any of the IUCN criteria for Critically Endangered (see the IUCN Red List Categories and Criteria: Version 3.1, 2001), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
EN	A taxon is **Endangered** when the best available evidence indicates that it meets any of the IUCN criteria for Endangered (see the IUCN Red List Categories and Criteria: Version 3.1, 2001), and it is therefore considered to be facing a very high risk of extinction in the wild.
VU	A taxon is **Vulnerable** when the best available evidence indicates that it meets any of the IUCN criteria for Vulnerable.
NT	A taxon is **Near Threatened** when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered, or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future.
LC	A taxon is **Least Concern** when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable, or Near Threatened. Widespread and abundant taxa are included in this category.
DD	A taxon is **Data Deficient** when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.
NE	A taxon is **Not Evaluated** when it is has not yet been evaluated against the criteria.

* Note: IUCN status not provided for species that are ranked LC, DD, or NE.

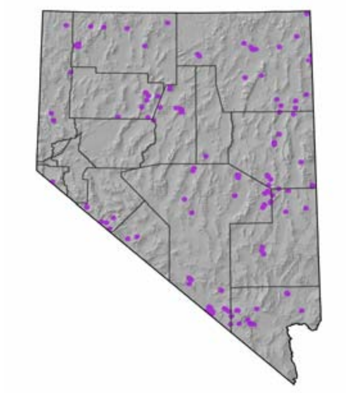
National Audubon Society (NAS) WatchList

Determining the placement of a bird on the NAS WatchList is based on the assessment of four factors: population size, range size, threats, and population trend (Panjabi et al. 2005). Each of these factors is scored on a scale of one to five, where one means low vulnerability to extinction due to that factor and five means high vulnerability. For range size and threats, separate scores are calculated for breeding and non-breeding seasons; to create a combined national score, only the highest of the respective breeding and non-breeding scores is used. Thus, the combined score is a sum of four scores and ranges from four to 20.

Code	Definition
Red WatchList	**Highest National Concern**—a combined score of 16, plus a score of eight or more for threats plus trend, and a score of eight or more for range size plus population size
Yellow WatchList (rare list)	**Rare List**-a species needs a combined score of 14, a score of eight or more for range size plus population size, and a score of seven or less for threats plus trend.
Yellow WatchList (declining list)	**Declining List**-a species needs a combined score of 14, a score of seven or more for threats plus trend, and a score of seven or less for range size plus population size.

Other statuses indicated in the species accounts include Partners in Flight (PIF) Priority Bird Species and American Fisheries Society (AFS) designations. In these cases, the statuses are self explanatory within the Agency Status box of the species account.

A number of species in the genera Eremopyrgus, Fluminicola, Juga, Pyrgulopsis, and Tryonia are included in the 2012 WAP due to their localized populations and susceptibility to a number of threats including water issues, exotic species invasion, development, trampling by livestock and wild horses, and climate change.



Agency Status	
NV Natural Heritage	
USFWS	No Status

TREND: Trend varies depending on the conditions at each location.

DISTRIBUTION: Highly localized across the state.

GENERAL HABITAT AND LIFE HISTORY:

Many species of endemic aquatic gastropods are a remarkable remnant of episodes in the Great Basin's history when extensive waterways covered the area. During the past two million years, these high water stands occurred at roughly 100,000-year intervals, with the lakes and rivers rising for the last time about 13,000 years ago. Each time the region dried up, springsnails and other aquatic species were stranded in isolated colonies, surviving only within the sharply defined boundaries of the small springs, seeps, and wetlands. When large lakes and rivers disappeared, the salts and minerals of the local soils, and the geochemistry and geothermal aspects of the surviving aquifers, concentrated their influence on the small, residual ecosystems. As the isolated springsnail populations adapted to the conditions of each inhabitable water source, an inevitable process of evolution created the multiple species being discovered continually today. (Doherty 2002). Very little is known about the life history of NV's endemic gastropods.

CONSERVATION CHALLENGES:

Species in the genus Pyrgulopsis are particularly susceptible to extinction because the entire population of any single species is often tied to a single spring. Such sites may be no more than a few square meters and easily destroyed by water diversion, capping, groundwater pumping, invasive or exotic species, development, or trampling by livestock. Even within an individual spring system the suitable habitat for and distribution of endemic gastropods may be limited to unique, small micro-habitats because of distance from the spring source, thermal and substrate characteristics, velocity, and other factors. Hence, these species may be particularly sensitive to disturbance and site alteration even when it includes only a small part of a spring system.

NEEDS:

Research Needs: Additional spring surveys are needed to assess the presence or absence of aquatic gastropods and to fully describe the taxonomy and biogeographical features of these genera. Little is known about the life history of each species, and much basic biology remains to be done.

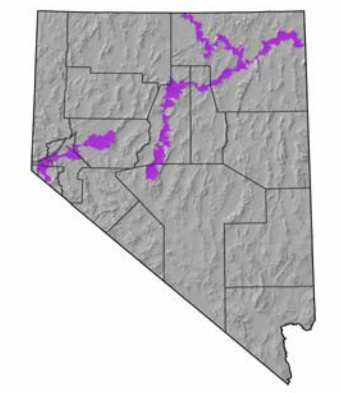
Monitoring and Existing Plans: Approximately 300 springs were visited in 2008 and 2009 to determine their current condition and if sensitive aquatic gastropods were present. The results of these surveys, a partnership between The Nature Conservancy, Desert Research Institute, and Nevada Natural Heritage Program, are included in the Nevada Springs Conservation Plan (Abele 2011).

Approach: In 1998, six federal land management and resource agencies, along with the Smithsonian Institution and The Nature Conservancy, signed a Memorandum of Understanding to work to conserve the nearly 100 species of aquatic gastropods in habitats on federal and Nature Conservancy lands in the Great Basin. The agencies and involved scientists are working to identify threatened habitats and raise the awareness of a broad range of springs stakeholders throughout the West. (Doherty 2002). An effort needs to be made to develop productive working relationships with private landowners and to help these landowners meet their needs while managing springs to the maximum benefit of these species.

WAP HABITAT LINKS: Springs and Springbrooks

California floater *Anodonta californiensis*

WAP 2012 species due to its susceptibility to a number of threats including water issues, exotic species invasion, climate change, and development.



Agency Status	
NV Natural Heritage	G3QS1
USFWS	No Status
BLM-NV	Sensitive
USFS-R5	Sensitive
CCVI	Moderately Vulnerable

TREND: Trend is unclear although based on evidence from elsewhere, this species is almost certainly declining.

DISTRIBUTION: Historically found within the Humboldt and Truckee river basins. May also have been in Carson or Walker Rivers. Some authors believe all occurrences in Nevada to be historical.

GENERAL HABITAT AND LIFE HISTORY:

The California floater exists in shallow muddy or sandy habitats in larger rivers, reservoirs, and lakes.

Embryos develop into larvae called glochidia, which are released by the female and attach to a host fish. The full range of host fish are not known, but they may parasitize native minnows as well as the nonnative mosquito fish. During breeding, males release sperm into the water and females must inhale it for fertilization to occur. The California floater reaches maturity within 4-5 years and has a life span of 10-15 years.

CONSERVATION CHALLENGES:

Vulnerable to pollution; diversion of rivers for irrigation, hydroelectric, and water supply projects; elimination of natural fish hosts; eutrophication due to agricultural runoff and urbanization; and impoundments. The California floater thrives in reservoirs, but many reservoirs experience severe annual water-level fluctuations that impact the standing crop of mussels in shallow water. During continued drought some habitats may dry up completely, as was the case for Washoe Lake in 2004. Nonnative species may compete with their host fish or eat young mussels (e.g., common carp).

NEEDS:

Research Needs: Determine potential host fishes. Identify potential suitable range and characterize current distribution and occurrence in NV. Assess genetics to determine range-wide population structure.

Monitoring and Existing Plans: This species is not currently monitored and does not occur in any other existing plans.

Approach: Continue interaction with the Northwest Freshwater Mussel Working Group (NWFMWG). Through an outreach program, solicit volunteers/researchers to conduct distribution surveys, using the recently developed guide to freshwater mussels of the northwest, and protocols recommended by the working group. Encourage select volunteers and researchers to collect appropriate samples for genetic evaluation; provide written guidance for sample collection. Partner with aquatic field biologists and ecologists to collect information while conducting other projects in habitats that could support freshwater mussels.

WAP HABITAT LINKS: Lakes and Reservoirs, Intermountain Riparian.

Ash Meadows Amargosa pupfish — *Cyprinodon nevadensis mionectes*

WAP 2012 species due to impacts from introduced detrimental aquatic species, habitat degradation, and federal endangered status.

Agency Status	
NV Natural Heritage	G2T2S2
USFWS	LE
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Presumed Stable

TREND: Trend is stable to increasing with continued on-going restoration activities.

DISTRIBUTION: Springs and associated springbrooks, outflow stream systems and terminal marshes within Ash Meadows National Wildlife Refuge, Nye Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

This species is isolated to warm springs and outflows in Ash Meadows NWR including Point of Rocks, Crystal Springs, and the Carson Slough drainage. Pupfishes feed generally on substrate; feeding territories are often defended by pupfishes. Diet consists of mainly algae and detritus however, aquatic insects, crustaceans, snails and eggs are also consumed. Spawning activity is typically from February to September and in some cases year round. Males defend territories vigorously during breeding season (Soltz and Naiman 1978).

In warm springs, fish may reach sexual maturity in 4-6 weeks. Reproduction variable: in springs, pupfish breed throughout the year, may have 8-10 generations/year; in streams, breeds in spring and summer, 2-3 generations/year (Moyle 1976). In springs, males establish territories over sites suitable for oviposition. Short generation time allows small populations to be viable. Young adults typically comprise most of the biomass of a population. Compared to other C. nevadensis subspecies, this pupfish has a short deep body and long head with typically low fin ray and scale counts (Soltz and Naiman 1978).

CONSERVATION CHALLENGES:

Being previously threatened by agricultural use of the area (loss and degradation of habitat resulting from water diversion and pumping) and by impending residential development, the TNC purchased property, which later became the Ash Meadows NWR. The majority of pupfish habitats in Ash Meadows were significantly altered during agricultural development through the modification of spring pools and outflows and the construction of Crystal Reservoir and irrigation ditches. Introduced aquatic animals (fishes, crayfish, bullfrogs, snails) remain a problem in some sites. Largemouth bass eliminated the pupfish from the main pool of Crystal Spring, but pupfish that survived in the outflow reoccupied the spring when bass were eradicated (Minckley and Deacon 1991). Habitat may be threatened by groundwater pumping demands in adjacent and regional aquifers.

NEEDS:

Research Needs: Continue assessment of habitat requirements to direct ongoing habitat restoration efforts. A genetic management plan is currently in progress (Martin, A. In press).

Monitoring and Existing Plans: Status monitoring is conducted annually by NDOW and USFWS to assess trend and response to ongoing habitat restoration efforts. There is an existing Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Recent land acquisitions and continued habitat restoration efforts have enhanced populations in many of the outflow springs.

Approach: Periodically monitor populations and habitat. Ensure the perpetuation of multiple populations. Current efforts for planning and restoration of occupied and historic habitats within Ash Meadows NWR will be continued. Key elements of the approach include continued efforts for control and removal of invasive species including largemouth bass, green sunfish and cichlids, reconstruction of altered spring outflows and marsh habitats to approximate historic conditions, and restoring connectivity between various outflow systems.

WAP HABITAT LINKS: Springs and Springbrooks, Marshes.

Ash Meadows speckled dace *Rhinichthys osculus nevadensis*

WAP 2012 species due to impacts from introduced detrimental aquatic species and federal endangered status.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Small populations with limited recruitment.

DISTRIBUTION: Springs and associated springbrooks, outflow stream systems within Ash Meadows National Wildlife Refuge, Nye Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

In Ash Meadows dace historically occupied many of the same habitats as the Ash Meadows Amargosa pupfish. Current distribution is largely limited to cooler spring source pools and springbrook outflows. Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

The speckled dace eats various small aquatic animals.

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Spawning occurs in spring and summer over stream riffle habitat. Adult maximum length is 10 cm (4 inches) and longevity up to 4 years (USFWS 1990b).

CONSERVATION CHALLENGES:

Extremely limited population size and distribution. Previously threatened by agricultural use of the area (loss and degradation of habitat resulting from water diversion and pumping) and by impending residential development; TNC purchased the property, which later became the Ash Meadows NWR. The majority of dace habitats in Ash Meadows were significantly altered during agricultural development through the modification of spring pools and outflows and the construction of irrigation ditches. The loss of connectivity between dace habitats within Ash Meadows has significantly impacted this subspecies. Introduced aquatic animals (fishes, crayfish, bullfrogs, snails) remain a problem. Habitat may be threatened by groundwater pumping demands in adjacent and regional aquifers.

NEEDS:

Research Needs: Effective methods for control of introduced species. Additional life history and habitat requirements information to guide habitat restoration efforts. Continue to monitor re-introduction populations.

Monitoring and Existing Plans: Annual monitoring by USFWS and NDOW. Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Recent restoration of spring outflow systems and consequent re-introduction of dace show encouraging results and limited recruitment. Recent purchase of private inholdings on AMNWR have further enhanced dace habitat.

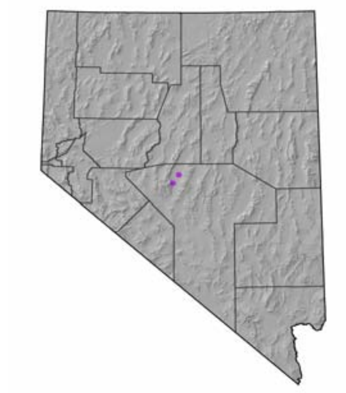
WAP HABITAT LINKS: Springs and Springbrooks.

Approach: Current efforts for planning and restoration of occupied and historic habitats within Ash Meadows NWR will be continued. Key elements of the approach include continued efforts for control and removal of invasive species including largemouth bass, green sunfish and cichlids, reconstruction of altered spring and outflows habitats, and restoring connectivity between various outflow systems. Non-native crayfish/dace interactions appear to be one of the largest challenges to persistence.

WAP HABITAT LINKS: Springs and Springbrooks.

Big Smoky Valley speckled dace — *Rhinichthys osculus lariversi*

WAP 2012 species due to habitat degradation from detrimental grazing practices and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
State Prot	Sensitive Fish NAC 503.067
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Known from 3 locations in Big Smoky Valley, Nye Co.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats; springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well as zooplankton; diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age three. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

Known locations may all be on private lands; access for assessment and monitoring is difficult. Habitat is degraded.

NEEDS:

Research Needs: Current and detailed information on distribution, habitat quality and habitat suitability, current status.

Monitoring and Existing Plans: No specific monitoring in place. No species specific planning or applicable plans in place.

Approach: To be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian, Intermountain Riparian.

Big Spring spinedace *Lepidomeda mollispinis pratensis*

WAP 2012 species due to its limited distribution in NV, habitat degradation, vulnerability to climate change, and federal threatened status.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Moderately Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Very small range in Meadow Valley Wash, NV.

GENERAL HABITAT AND LIFE HISTORY:

Adults inhabit runs and pools with a depth of at least 0.25 m. Individuals are often collected in association with instream cover, slow moving runs, quiet eddies downstream of riffles, or below minor barriers. Young-of-the year and larvae occupy quiet pools and runs. Reproduction occurs between April and early July at water temperatures from 10° C (April) to 15°C (July). Gravid females had 100-1,400 maturing eggs. Larvae were present from early May to August. Exceptional individuals may live to four years and obtain a length of 120 mm. Adults feed on invertebrates on the surface and substrate. Piscivory occurs in larger individuals as one individual had a tiny speckled dace in a stomach content analysis (Minckley and Marsh 2009). Allan (1983) also noted a preference for areas where leafy aquatic vegetation and/or overhanging banks were present.

These fish probably feed opportunistically, mainly on aquatic insect larvae and also on algae and other plant material. Watercress may be an important habitat for food organisms.

Individuals positioned behind stream cover, particularly watercress along the stream margin, have been observed to dart into the current to inspect or ingest potential food items and quickly return to their original positions (Langhorst, pers. obs.). Big Spring spinedace lives sympatrically with two other native fish species: speckled dace (Rhinichthys osculus subsp.) and desert sucker (Catostomus clarki subsp.). Non-native species have been illegally released and include rainbow trout (Oncorhynchus mykiss), largemouth bass (Micropterus salmoides), white crappie (Pomoxis annularis), and a crayfish (species unknown). Only the crayfish is known to reproduce in the Condor Canyon reach of Meadow Valley Wash. Spawning sites are in lower ends of pools where males congregate and females move to the males to spawn on or near the bottom.

CONSERVATION CHALLENGES:

This sub-species is restricted in distribution to a single isolated 5 km (3.1 mile) reach of Meadow Valley Wash, and vulnerable to extirpation from natural causes (e.g., major flood, severe drought), habitat alteration, ground water depletion, release of toxic substances, or introduction of exotic species. It was listed as threatened by the U.S. Fish and Wildlife Service in 1985. Although this area is closed to livestock grazing and has limited public access, a major rangeland fire event in 1999 removed much of the riparian cover associated with occupied spinedace habitat and also upland vegetation in the immediate watershed. Initial post-fire rehabilitation efforts were limited in effectiveness; the loss of large riparian overstory has increased emergent vegetation such as cattails impacting aquatic habitat quality and the loss of upland vegetation has increased sediment and silt deposition negatively affecting substrate in occupied aquatic habitats. Potential locations for establishment of a second spinedace population are limited.

NEEDS:

Research Needs: Research is needed on life history, ecology, interactions with non-native species, and reactions to man-made disturbances. The upper reaches of the range (Kill Wash) need to be further studied and surveyed as all native fishes in the system in all age classes were present.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian.

Monitoring and Existing Plans: Annual monitoring of the single extant population is conducted by NDOW with assistance from the Recovery Implementation Team (RIT). Management and recovery needs are described in the Big Spring Spinedace Recovery Plan and the supplementary Recovery Implementation Plan.

Approach: Nonnative species control is conducted in association with population monitoring. RIT team is developing habitat management and restoration strategy. Efforts to establish a second population within the Meadow Valley Wash drainage are ongoing. Recovery Implementation Plan (NDOW 2000a) provides guidance for conservation actions. BLM has designated the immediate watershed as an ACEC. Planning has been completed for additional restoration of key habitat reaches with funding to start in 2012.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian.

bonytail chub *Gila elegans*

WAP 2012 species due to federal endangered status and possible exinction of the Lower Colorado River wild population.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
USFS-R4	Endangered
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Distribution is restricted to the Colorado River system. In Nevada, distribution is limited to Lake Mohave and possibly the Colorado River below Davis Dam.

GENERAL HABITAT AND LIFE HISTORY:

Bonytail chub are found in the main stream of the Colorado River and large tributaries, usually in or near deep swift water, in flowing pools and backwaters, over mud or rocks. They are most frequently associated with eddies just outside the main current, and have a high tolerance for turbidity (Matthews and Moseley 1990). They also occupy mainstem Colorado River reservoirs. Available data suggest that habitats required for conservation include river channels and flooded, ponded, or inundated riverine habitats, especially those where competition from non-native fishes is absent or reduced (USFWS 1994b).

This species is a surface feeder. Adults primarily eat terrestrial insects, plant debris, and algae, but can be an active predator on early life stages of other native and nonnative fishes. Young feed mainly on aquatic insects.

Bonytail chub spawned in Lake Mohave (1954) over a gravel bar in 9 m (29.5 ft) of water. They spawn in schools over rocky shoals of smaller tributaries (Matthews and Moseley 1990).

CONSERVATION CHALLENGES:

Only a few scattered remnant populations remain in the wild. Reproduction and recruitment in the wild is extremely limited and may be almost entirely absent in the lower Colorado River Basin. Declines have apparently been caused mainly by the effects of dams and reservoir construction, channelization and loss of seasonal floodplain habitats in remaining riverine reaches, and the establishment of nonnative predators and competitors in altered habitats. Wild populations have declined greatly since the 1960s. The wild population in Lake Mohave consisted of older adult individuals with little or no recruitment and is likely extirpated. Population size and recruitment is similarly very limited throughout the species range although efforts to release larger (>300mm (1 ft)) reared fish from captive stock have shown some success. Future conservation efforts are dependent on captive individuals held at Dexter NFH, New Mexico and other facilities. Hybridization may occur between bonytail, humpback chub and/or roundtail chub where they co-occur (USFWS 2002a).

NEEDS:

Research Needs: Intraspecific and habitat relationships, culture methods, and habitat restoration strategies are needed.

Monitoring and Existing Plans: Annual monitoring of the Lake Mohave population is conducted by the Native Fish Work Group including USBR, USFWS, NDOW, AGFD and ASU. Available planning documents include the Bonytail Chub Recovery Plan & Recovery Goals Addendum; Lower Colorado River Basin Native Fish Management Strategy; Management Plan for the Big River Fishes of the Colorado River Basin; Covered Species in the Lower Colorado River MSCP.

WAP HABITAT LINKS: Warm Desert Riparian.

Approach: Current efforts for bonytail conservation are focused on re-establishment of persistent adult populations in mainstem reservoirs, and riverine habitats where available, primarily using cultured adult broodstock to produce large juvenile (>300mm (1 ft)) fish for release to the wild because of the absence of wild stocks. See Minckley and Deacon (1991) for information on hatchery culture of bonytail. The future potential for re-establishing wild reproducing populations is dependent on limited areas where seasonal floodplain habitats and flow regimes can be reconstructed to some degree, integrating some level of control on nonnative predators and competitors, primarily in relic mainstem riverine areas and tributaries. Some limited success has been demonstrated in establishing off channel refuge populations in ponds and wetlands (Mueller et al 2004). Conservation strategies for Nevada bonytail habitats are being implemented by the Lower Colorado River MSCP program and the Native Fish Work Group to both of which NDOW is a cooperator. Recovery and conservation strategies for this species are outlined in the species recovery goals (USFWS 2002a) and Lower Colorado River Basin native fish management plan (USFWS 2005). Wild (non-cultured) fish may be extinct in lower Colorado River, maintenance of existing recovery efforts (repatriate adults) is critical to prevent extinction.

WAP HABITAT LINKS: Warm Desert Riparian.

bull trout (Jarbidge River basin pop) *Salvelinus confluentus pop. 4*

WAP 2012 species due to its federal threatened status, limited spawning and rearing habitat, and climate change vulnerability.

Agency Status	
NV Natural Heritage	G4T2QS1
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Game Fish NAC 503.060
AFS	Threatened
CCVI	Highly Vulnerable

TREND: Trend is stable.

DISTRIBUTION: In NV, distribution is believed to consist of a single population in the East Fork, West Fork, and mainstem Jarbidge River and headwater tributaries; isolated from other bull trout by a large expanse of unsuitable habitat (USFWS 1999).

GENERAL HABITAT AND LIFE HISTORY:

Bull trout inhabit the bottom of deep pools in cold rivers and large tributary streams, often in moderate to fast currents with temperatures of 7-10° C (45-50° F), in addition to, large coldwater lakes and reservoirs. In the contiguous U.S., they are now extirpated in most large rivers that historically were inhabited, and confined mostly to headwater streams. Conditions that favor the persistence of populations include stable channel, relatively stable stream flow, low levels of fine substrate sediments, high stream channel complexity with various cover types, temperatures not exceeding about 15 C (59 F), and the presence of suitable corridors for movement between suitable winter and summer habitats and for genetic exchange among populations (Rieman and McIntyre 1993). Available information indicates that bull trout and other native fishes use different resources, reducing direct competition (Rieman and McIntyre 1993).

Bull trout usually spawn in gravel riffles of small tributary streams, including lake inlet streams. Spawning sites often are associated with springs (Rieman and McIntyre 1993). Young are closely associated with stream channel substrates (Rieman and McIntyre 1993). Areas with large woody debris and rubble substrate are important as juvenile rearing habitat (Spahr et al. 1991). Bull trout spawn in late summer or fall, with falling temperatures between 5-9° C (41-48° F). Eggs hatch in late winter or early spring. Fry emerge from gravel in April-May. Most information indicates that sexual maturity is attained in 5-7 years. Spawning populations may comprise 4 or more year classes, though 1-2 year classes may dominate. See Rieman and McIntyre (1993).

CONSERVATION CHALLENGES:

Small range, low abundance, and disjunct distribution are all conservation issues. Past activities, such as mining, road development and maintenance, stream channelization and removal of large woody debris, residential development, and road and campground development of USFS lands, still negatively impact populations (USFWS 2004). Road construction and associated maintenance activities threaten habitat. Introduced brown trout and rainbow trout have been associated with bull trout declines, apparently due to competitive interactions. Lake trout may have a negative impact on bull trout, due to predation by lake trout on juvenile bull trout, probable competitive interactions, and increased harvest associated with increased fishing pressure for lake trout (see Rieman and McIntyre 1993). Bull trout are threatened by activities that damage riparian areas and cause stream siltation. Logging, road construction, mining, and overgrazing may be harmful to spawning habitat. Habitat fragmentation may be a problem, but it is unclear whether the fragmented distribution is natural due to specific habitat requirements or caused by human impacts (Rieman and McIntyre 1993).

NEEDS:

WAP HABITAT LINKS: Intermountain Riparian.

Research Needs: It is necessary to Identify and assess trends in habitat conditions and bull trout abundance (Rieman and McIntyre 1993). Top priority should be given to areas with the greatest threats. Research is needed to determine the range of conditions (especially temperature) tolerated by stable populations. Similarly, investigation is needed on metapopulation structure, dynamics, and dispersal, the role of the resident and migratory forms in population persistence, and the interactions between these forms.

Monitoring and Existing Plans: Monitored during NDOW stream surveys. Existing plans include the Bull Trout Recovery Plan and Bull Trout Species Management Plan.

Approach: Conservation of bull trout will require maintenance or restoration of multiple, high-quality, connected habitats distributed throughout conservation areas, which in turn should be distributed throughout the species range (Rieman and McIntyre 1993). Effective conservation of the species and its inherent diversity requires an interregional approach (Rieman and McIntyre 1993). Rieman and Allendorf (2001) concluded that cautious long-term management goals for bull trout populations should include an average of at least 1,000 adults spawning each year. Where local populations are too small, managers should seek to conserve a collection of interconnected populations that is at least large enough in total to meet this minimum (Rieman and Allendorf 2001). Also, full expression of life history variation and the natural processes of dispersal and gene flow should be provided (Rieman and Allendorf 2001). Continue the long-term monitoring plan as identified by the Jarbidge River Bull Trout Recovery Team.

WAP HABITAT LINKS: Intermountain Riparian.

Clover Valley speckled dace *Rhinichthys osculus oligoporus*

WAP 2012 species due to its federal endangered status, low population numbers, limited distribution, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Highly Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Three spring systems in Clover Valley, Elko Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

Clover Valley speckled dace are found primarily in reservoirs and outflows of the three spring systems: Clover Valley Warm Springs, Wright Ranch Spring, and Bradish Spring. There do not appear to be any associated marshes with these springs, only the outflows that have been heavily modified.

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Details of Clover Valley speckled dace seasonal habitat requirements, population size, distribution over time, reproductive potential, and available habitat are unknown because access to the properties to conduct studies was not permitted in the past. Generally, speckled dace are characterized as diurnal (active during the daytime), bottom browsers that feed primarily on small invertebrates (such as aquatic insects), plant material, and zooplankton (floating, microscopic aquatic animals). Specific reproductive patterns of the Clover Valley speckled dace have not been examined. Generally, speckled dace mature in their second summer. They are capable of spawning throughout the summer, but peak activity usually occurs in the months of June and July at water temperatures of 18° C (65° F) (USFWS 1998a).

CONSERVATION CHALLENGES:

Primary threats at the time of listing were a limited distribution, habitat manipulation, small population size, and nonnative fish (e.g., rainbow trout) introductions. All occupied habitats are on private lands with limited access ability.

NEEDS:

Research Needs: Determine life history characteristics and habitat requirements.

Monitoring and Existing Plans: Monitoring and inventory of this subspecies has been conducted by USGS-BRD and USFWS. NDOW conducts annual population monitoring. Included in the Recovery Plan for the Endangered Species of Clover & Independence Valleys.

Approach: Work with private landowners to develop conservation strategies. Secure water rights where necessary to protect spring flows and spring outflows. Exclude sensitive springs from direct impacts of grazing, recreation, other disturbance sources. Eliminate groundwater pumping that threatens surface flows at critical springs. Eliminate introduced species that compete with dace.

WAP HABITAT LINKS: Springs and Springbrooks.

Cui-ui *Chasmistes cujus*

WAP 2012 species due to its federal endangered status and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Moderately Vulnerable

TREND:

DISTRIBUTION: Occurs only in Pyramid Lake and Truckee River, NV.

GENERAL HABITAT AND LIFE HISTORY:

Cui-ui prefer inshore areas of the lake with extensive shoals and shallow bars. They generally avoid deep-water areas and inshore areas with steep dropoffs (though Page and Burr [1991] described the habitat as "deep water"). Usually this is at less than 46 m (Sigler and Sigler 1987). The cui-ui spawns in the Truckee River over gravel beds in relatively shallow water (21-140 cm) where flow is rapid. When runs are disturbed by low water levels, they may spawn at the river mouth. Cui-ui may spawn in Pyramid Lake, but extreme alkalinity and elevated salinity preclude successful reproduction there (Scoppettone and Vinyard 1991). Newly emerged young remain a few days or weeks in the spawning stream.

The cui-ui feeds mainly on bottom-oriented zooplankton and macroinvertebrates such as ostracods, CYCLOPS, and chironomid larvae and pupae (Scoppettone and Vinyard 1991). Cui-ui feed somewhat above the bottom in water 10-30 m deep. (Sigler and Sigler 1987).

Most adult mortality probably occurs during spawning runs (Sigler et al. 1985). Direct predation by humans was a significant cause of mortality until the 1970s. In recent years white pelicans have become a significant source of mortality (Scoppettone and Vinyard 1991).

CONSERVATION CHALLENGES:

Endangered status is due to habitat alteration (siltation, pollution) and declining flow in Truckee River (dam construction and water diversion). Current threats include, as previously stated, inadequate water flow in the Truckee River (this being a major threat), declining water quality resulting from the expanding urban population, and increased salinity in the lake that could result from mass water diversions. Ownership of water rights in the Truckee basin has been in dispute and subject to litigation for many years (Scoppettone and Vinyard 1991).

NEEDS:

Research Needs: None identified.

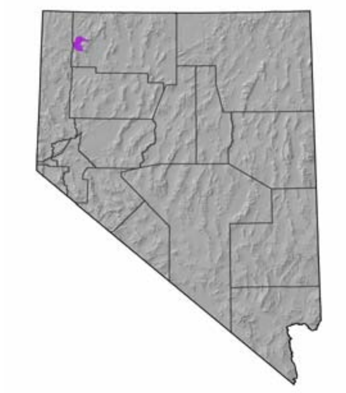
Monitoring and Existing Plans: The cui-ui is Monitored by USFWS and covered in the Cui-ui Recovery Plan.

Approach: Maintain adequate water level in Pyramid Lake is necessary to meet the life history needs (especially spawning) of this species. Adequate flow of less than 14 C should be maintained during spawning. Spawning gravel and shaded riparian zone in lower Truckee River should be protected and enhanced, and access to the river should be maintained (Sigler et al. 1985).

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

desert dace *Eremichthys acros*

WAP 2012 species due to its federal threatened status, endemism, impacts from detrimental aquatic species, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Threatened Fish NAC 503.065.3
CCVI	Moderately Vulnerable

TREND: Despite small, isolated populations, currently the entire population is considered stable. However, many threats still persist in its range.

DISTRIBUTION: Restricted to thermal habitats in the Soldier Meadow area, an elevated basin (1,524 m) in western Humboldt County, NV (Lee et al. 1980). Currently it occupies 8 thermal spring and related outflows consisting of 3.1 miles of total habitat.

GENERAL HABITAT AND LIFE HISTORY:

Desert dace occupy habitat in 8 thermal springs and their outflow consisting of 3.1 miles total, in areas with temperatures of 18-40° C (64-104° F). They are most common in temperatures of 23-29° C (73 - 84° F), downstream of spring orifices. It was found that desert dace are distinguished as having the highest temperature tolerance for minnows (Hubbs and Miller 1948). From recent survey work, desert dace appear to favor open water where little or no vegetation exist.

Desert dace are omnivorous, but eat mainly periphyton and filamentous algae (1996 draft recovery plan).

Temperatures of 21-24° C (70 - 75° F) are required for spawning. Desert dace probably breed throughout early and midsummer (Sigler and Sigler 1987), or year round (Matthews and Moseley 1990).

CONSERVATION CHALLENGES:

Habitat formerly was threatened by channelization and water diversion (which change thermal environment and reduce food supply) and potential geothermal and/or mineral development. Existing and potential threats include exotic species (predatory fishes such as green sunfish and catfish, parasites associated with non-native fishes), trampling and overgrazing by livestock and wild horses and burros, and increasing recreational use of habitat. Habitat alteration by ungulates has been addressed in the majority of dace habitats through BLMs exclosure fencing in 2004. Effectiveness at excluding grazers has yet to be determined.

NEEDS:

Research Needs: Research is needed to determine interdependency of the springs.

Monitoring and Existing Plans: Included in the Recovery Plan for the Rare Species of Soldier Meadows (USFWS 1997d). There was a comprehensive survey and inventory of the entire system by USGS in 2003. A livestock grazing plan was implemented in 2007. NDOW conducts annual monitoring surveys and a RIT team exists. Gabion barriers have been installed to prevent non-native green sunfish from existing habitat.

Approach: The entire aquifer should be treated as a unit. Habitat should be restored and threats from grazing ungulates and exotic aquatic organisms should be eliminated. For specific recovery objectives, see the Recovery Plan for the Rare Species of Soldier Meadows (USFWS 1997d). Vinyard (1996) recommended that irrigation diversion should be discontinued and water returned to the original channel.

WAP HABITAT LINKS: Springs and Springbrooks.

Devils Hole pupfish *Cyprinodon diabolis*

WAP 2012 species due to its federal endangered status, limited distribution, and water level threats.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: The number of fishes in Devils Hole has declined since the mid 1990's. Refugia populations at Hoover Dam and Ash Meadows NWR have been lost due to hybridization, invasive species, water supply issues, and other problems. Intense management actions have been implemented in the form of a Devil's Hole pupfish Incident Command Team (ICT) to direct efforts intended to preclude this species from extinction. The population in Devils Hole appears to have stabilized at slightly over 100 adult fish after reaching a low of 38 fish in 2006.

DISTRIBUTION: Wild population occurs only in Devils Hole, Ash Meadows area, Death Valley National Park, NV.

GENERAL HABITAT AND LIFE HISTORY:

Devils Hole pupfish exist in a deep limestone pool, about 15 m (49 ft) below the land surface. Water temperature is 32.8-33.9°C (91-93°F), and dissolved oxygen is 1.8 to 3.3 ppm (Lee et al. 1980). The species relies predominantly on an algae-covered, shallow shelf for food resources and spawning substrate for reproduction. The Devils Hole pupfish eats mainly algae. It is also known to ingest small invertebrates, but these items may be ingested secondarily while it grazes over rocks (La Rivers 1962). Pupfish also use the deep cavern habitat but move onto the shallow shelf daily to access food resources. Devils Hole pupfish are short-lived with few if any fish living more than one year in the wild.

There is a relatively stable population of slightly over 100 adult fish. The population fluctuates seasonally with lower numbers in winter. Reproduction occurs throughout the year with the bulk of recruitment occurring in the late spring to early summer period.

CONSERVATION CHALLENGES:

This site is vulnerable to vandalism and factors that affect substrate, water level, or water quality. There is a high susceptibility towards extinction due to possible impacts from groundwater pumping or catastrophic events affecting the single occupied habitat. All off-site refuge populations have been lost from water supply problems or hybridization with other pupfish. Quality and suitability of essential spawning habitat in Devils Hole has been impacted from storm events and excess sediment deposition, with substantial reduction in the population size within Devils Hole. Water level decline and exposure of shelf, is a major concern as there is only a single wild population.

NEEDS:

Research Needs: Life history studies are needed to identify opportunities for maintenance and enhancement of habitat and population size. Genetic management planning for future refuge populations is under development. The causes for recent population declines in Devils Hole are still not well understood but may be related to dynamic changes in the food web and energy balance in Devils Hole. A new "Desert Fish Research Facility" has been constructed on Ash Meadows NWR which will house a Devils Hole pupfish refuge population.

Monitoring and Existing Plans: This site is surveyed semi-annually in April and October by NPS, USFWS, and NDOW and is under intense management. Monitoring of larval production is conducted by NPS annually in the spring. Devils Hole pupfish is included in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada.

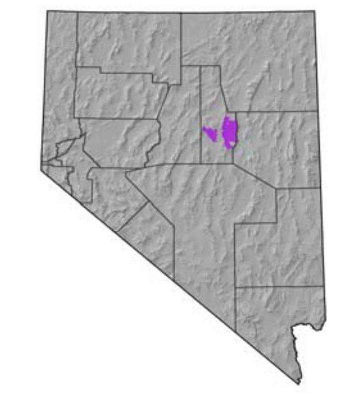
WAP HABITAT LINKS: Springs and Springbrooks.

Approach: Continue to monitor population. Maintain aquifer to sustain water levels in Devils Hole. Monitor water rights applications for potential effects. Maintain a refuge population. Goals and objectives are addressed in the species' Recovery Plan (USFWS 1990b), and actions are reviewed periodically by the Devils Hole ICT and the Devils Hole Pupfish Recovery Team. Current conservation and research efforts are focused on developing a strategy to rectify recent population declines in Devils Hole, and determining the role and appropriate management of refuge populations.

WAP HABITAT LINKS: Springs and Springbrooks.

Diamond Valley speckled dace *Rhinichthys osculus ssp. 10*

WAP 2012 species due to its unknown population status, endemism, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5THSH
USFWS	No Status
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Known from at least two locations in Diamond Valley, Eureka County.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing outflow streams for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

This is an endemic and its population status is unknown. Some populations may occur on private lands with access challenges.

NEEDS:

Research Needs: Information on life history, habitat requirements, and distribution is needed.

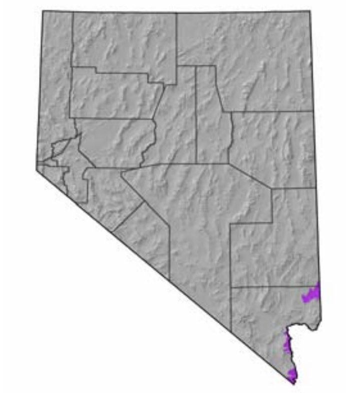
Monitoring and Existing Plans: No specific monitoring in place. No species specific planning or applicable plans in place.

Approach: Management approach to be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Warm Desert Riparian.

flannelmouth sucker *Catostomus latipinnis*

WAP 2012 species due to low population numbers and fragmented distribution.



Agency Status	
NV Natural Heritage	G3G4S1
USFWS	No Status
CCVI	Presumed Stable

TREND: Virgin River populations are low. but this is the most abundant native fish in Nevada reaches of that river. Lower Colorado River populations are stable but fragmented in distribution.

DISTRIBUTION: Endemic to tributary streams and rivers in the Colorado River basin. Nevada populations occur in the Virgin River and mainstem Colorado River below Davis Dam; occasional individuals are encountered in Lake Mead but are likely displaced from the Grand Canyon upstream and not resident.

GENERAL HABITAT AND LIFE HISTORY:

The flannelmouth sucker inhabits moderate to large rivers. It is seldom found in small creeks and is absent from impoundments. This species is typical of pools and deeper runs and often enters mouths of small tributaries (Lee et al. 1980) in addition to riffles and backwaters (Sublette et al. 1990). Young are usually found in shallower water than are adults (Sigler and Miller 1963). It spawns in riffles, usually over a substrate of coarse gravel (Lee et al. 1980).

The flannelmouth sucker is a bottom feeder. It is reported to feed on diatoms, algae, fragments of higher plants, seeds, and benthic invertebrates (Sigler and Miller 1963, Lee et al. 1980). See Tyus and Minckley 1988 for possible importance of Mormon cricket as a food source.

Flannelmouth sucker adults can be highly mobile, traveling several hundred miles in undammed river systems such as the Green River. Studies of flannelmouth below Davis Dam in the lower Colorado River have shown seasonal movement of up to 16 miles (Best and Lantow 2010).

CONSERVATION CHALLENGES:

The flannelmouth sucker currently occupies only about 45% of its historic range with 14 extant populations in the Colorado River Basin (Bezzerides and Bestgen 2002). Stable recently in the Little Colorado River (Douglas and Marsh 1998). This species is one of the few large-bodied native species that persist in the lower Colorado River basin, but it has been extirpated from the Gila River Basin and most of the mainstem Colorado River below Lake Havasu, CA/AZ. Apparently stable within the Navajo Nation, AZ (David Mikesic, pers. comm., 1997). Threats include alteration of the hydrologic, physical and thermal characteristics of river habitats (Clarkson and Childs 2000, Ward et al. 2002), blockage of migration routes due to dam construction, predation and competition by non-native aquatic species, and hybridization with other Catostomus species (Arizona Game and Fish Department 1995, 1996). Young suckers that exit warm tributaries and enter cold hypolimnetic water released from major dams may experience increased susceptibility to predation by rainbow trout and other predators (Ward and Bonar 2003). Extant populations in the Virgin River NV consist mostly of larger adults and the presence of nonnative predators combined with reduced base flows and altered habitats likely limits reproduction.

NEEDS:

Research Needs: Updated population information to determine trends is needed. It is necessary to determine abundance across range. Research is needed to determine effects of water temperature on ecology and life history and to determine effects of fluctuating water flows on movement, habitat use and preference, and recruitment in the Colorado River below Davis Dam. Additional information on seasonal habitat needs and use by juvenile fish is needed to guide restoration efforts on the lower Colorado River. Additional research needs have been identified for Grand Canyon populations which would be applicable to Nevada (Arizona Game and Fish Department 1995).

WAP HABITAT LINKS: Warm Desert Riparian.

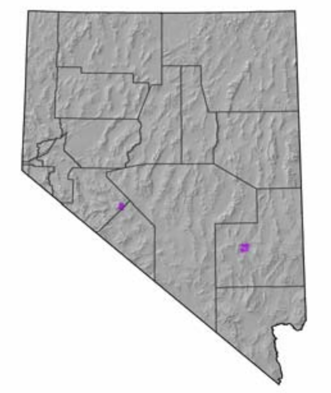
Monitoring and Existing Plans: NV Populations are monitored at least annually. Virgin River monitoring is included as part of other species efforts but could be expanded to better assess distribution, recruitment, demographics, population estimate. In the Colorado River annual monitoring efforts are led by USBR and USGS as part of the Lower Colorado Multispecies Conservation Program (LCR-MSCP) implementation program (Flannelmouth sucker is an LCR-MSCP covered species). The flannelmouth sucker is included in the Range-wide Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker; Lower Virgin River Recovery Implementation Strategy (draft), and the LCRMSCP Conservation Plan. It is also a High Priority Evaluation Species in the Clark County MSHCP.

Approach: The Range-wide Conservation Agreement for Roundtail Chub, Bluehead Sucker and Flannelmouth Sucker (UDWR 2004) outlines conservation program needs for this species. There are a number of multi-party conservation teams and plans in place to implement conservation for this species, including a range-wide agreement working group, the LCR-MSCP, and the Lower Virgin River Recovery Implementation Team (RIT) which directs and implements conservation actions on the Virgin River in Nevada. Key conservation elements include maintenance of flows, habitat protection and restoration, and the control of nonnative competitors and predators.

WAP HABITAT LINKS: Warm Desert Riparian.

Hiko White River springfish *Crenichthys baileyi grandis*

WAP 2012 species due to its federal endangered status, limited distribution, small population size, and threats from groundwater development and nonnative species.



Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend varies by site with both natural populations declining substantially since 2000 with the introduction of nonnative crayfish. Hiko Spring is very low but stable, Crystal Spring is low but increasing, and the refuge population has been stable in the absence of introduced nonnative species.

DISTRIBUTION: Endemic to Crystal and Hiko springs of the pluvial White River drainage in White River system, Pahranagat Valley, Lincoln County, southeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Hiko White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991). They are able to survive extremes in temperature and dissolved oxygen.

It is an opportunistic omnivore. Other subspecies, according to Sigler and Sigler (1987), are primarily herbivorous overall but also eat invertebrates (e.g., caddisfly larvae). Filamentous algae is the most important food.

Hiko White River springfish spawn in warm summer months. Apparently 10-17 eggs constitute a spawning. Eggs are laid and fertilized one at a time. Incubation lasts 5-7 days.

CONSERVATION CHALLENGES:

Distribution is limited to two sites on private land in Pahranagat Valley, and a refuge population on public land in Mineral County. Private land sites do not have protection or agreements in place for long term security of populations. The Hiko White River springfish is impacted by alteration and loss of occupied and historic habitat, invasive species, including severe impacts from introduced nonnative fishes and crayfish, water regulation for agriculture in occupied habitats, and potential effects of future ground and surface water development.

NEEDS:

Research Needs: Research is needed regarding habitat preference and requirements, interspecific competition, genetic management of isolated populations, the impacts of crayfish and nonnative species introductions, and control strategies for invasive aquatic species and plants.

Monitoring and Existing Plans: Population and status monitoring is conducted at least annually by NDOW at all sites. Existing plans include, Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley and the Pahranagat Valley Native Fishes Management Plan.

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. The RIT team implements the Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals, objectives, and actions. Key conservation elements include habitat restoration and protection, and aggressive control and removal of introduced nonnative fishes in occupied habitats. NDOW is pursuing development of landowner agreements to provide long term security for habitat through implementation of the Pahranagat Valley Programmatic Safe Harbor Agreement.

WAP HABITAT LINKS: Springs and Springbrooks.

Independence Valley speckled dace *Rhinichthys osculus lethoporus*

WAP 2012 due to its federal endangered status, limited distribution, threats from introduced detrimental aquatic species, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Highly Vulnerable

TREND: Trend is a stable, small, isolated population.

DISTRIBUTION: Isolated spring and marsh/outflow system in Independence Valley, Elko Co., NV.

GENERAL HABITAT AND LIFE HISTORY:

Independence Valley speckled dace are found in a temperate, permanent desert stream/marsh fed by six spring areas. Although known as Independence Valley (Ralph's) Warm Springs (Marsh), these springs are not cited as thermal waters. The species great adaptability and ability to inhabit a broad range of habitat types (Moyle 1976) allowed it to survive areas of the marsh system that were inaccessible to largemouth bass (Micropterus salmoides), and bluegill (Lepomis macrochirus), either do to shallowness or density of emergent vegetation (Rissler et al 2001). No data exists on the flow velocities or temperatures of habitat currently occupied by Independence Valley speckled dace. But recent survey work has shown that speckled dace occupy approx. 219 hectares of the springs and canals of the marsh (Rissler et al 2001).

Independence Valley speckled dace are bottom browsers that feed primarily on small invertebrates (such as aquatic insects), plant material, and zooplankton (floating, microscopic aquatic animals).

The speckled dace is one of the most morphologically (and ecologically) variable fishes in western North America (Miller and Miller 1948, Minckley 1973). This variability is due to geologic events that have resulted in numerous isolated populations. Generally, speckled dace are characterized as diurnal (active during the daytime). Specific reproductive patterns of the Independence Valley speckled dace have not been examined. Generally, speckled dace mature in their second summer. They are capable of spawning throughout the summer, but peak activity usually occurs in the months of June and July at water temperatures of 18°C (65°F) (USFWS 1998a).

CONSERVATION CHALLENGES:

Primary threats at the time of listing were a limited distribution, habitat manipulation, small population size, and nonnative fish introductions. All occupied habitats are on private lands with limited access ability.

NEEDS:

Research Needs: Research is needed to determine life history characteristics and habitat requirements. Genetic analysis funding was proposed at RIT meeting (2008).

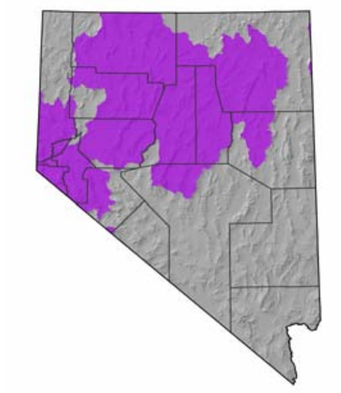
Monitoring and Existing Plans: Extensive inventory of this subspecies was completed by USGS-BRD in 1997-1998 (Rissler et al 2001). No scheduled monitoring is occurring at this time. There is a Recovery Plan for the Endangered Speckled Dace of Clover and Independence Valleys (USFWS 1998a).

Approach: Work with private landowners to develop conservation strategies. Secure water rights where necessary to protect spring flows and spring outflows. Exclude sensitive springs from direct impacts of grazing, recreation, other disturbance sources. Eliminate groundwater pumping that threatens surface flows at critical springs. Eliminate introduced species that compete with dace.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks, Marshes.

Lahontan cutthroat trout *Oncorhynchus clarkii henshawi*

WAP 2012 species due to its federal threatened status, habitat fragmentation, threats from exotic species and water development, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G4T3S3
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Nevada State Emblems
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Currently categorized as declining. Historically, 11 lacustrine populations occupied about 334,000 acres of lakes and an estimated 400-600 fluvial populations inhabited more than 5,800 km (3,600 miles) of streams. The Lahontan cutthroat trout currently exists in about 155 streams and 6 lakes and reservoirs (USFWS 1994f).

DISTRIBUTION: Formerly abundant in lakes and streams throughout the physiographic Lahontan basin of northern NV, eastern CA, OR, and UT. It currently exists in about 0.4% of former lake habitat and 11% of former stream habitat within its native range. In NV, the present range includes Pyramid Lake and the Truckee River (Washoe County); both forks of the Walker River and Walker Lake (Mineral County); Summit Lake and Carson River and its tributaries (Douglas and Lyons counties); Humboldt River and tributaries (Elko County); Lander, Eureka, Nye, and Humboldt Counties; and out-of-basin populations in Elko, Lander, Nye, and Clark counties. Independence and Summit Lakes support the only remaining reproducing lacustrine form within the native range. It has been introduced outside its native range, primarily for recreational fishing purposes (USFWS 1994f). Native populations are extirpated from Tahoe, Pyramid, Walker, and Donner lakes. The present population in Pyramid Lake derives from individuals of the same subspecies introduced from Summit Lake, Heenan Lake (Echelle 1991, Behnke 1992).

GENERAL HABITAT AND LIFE HISTORY:

The LCT inhabits lakes and streams and requires cool, well-oxygenated water. It is adapted to highly mineralized waters. In streams, the LCT uses rocky areas, riffles, deep pools, and areas under logs and overhanging banks. Optimally, cover should be available in at least 25% of the stream area. The LCT spawn in streams, generally in riffle areas over gravel substrate. Spawning and nursery habitat is characterized by cool water, approximate 1:1 pool-riffle ratio, well-vegetated and stable stream banks, and relatively silt-free rocky substrate in riffle-run areas (USFWS 1994f).

The LCT is an opportunistic feeder (Behnke 1992). Small individuals eat small invertebrates such as crustaceans and aquatic insects. Larger fishes eat large invertebrates and small fishes. Fishes dominate the diet of large, lake-dwelling adults.

Fry may move out of spawning tributaries shortly after emergence (Summit Lake population) or may remain in nursery streams for 1-2 years (USFWS 1994f).

CONSERVATION CHALLENGES:

This species is detrimentally affected by damage to spawning areas caused by timber harvesting, forest fires, and grazing livestock. It is also detrimentally affected by damming and water diversion for irrigation and municipal uses, water pollution downstream from Reno and Carson City, and by construction of Marble Bluff Dam which closed off spawning areas in the Truckee River headwaters (fish ladder now allows access). USFWS (1994f) stated that principal threats are habitat loss due to urbanization, reclamation, mineral development, livestock grazing, hybridization with non-native trout, and competition with exotic species of fishes. Many populations occupy isolated stream segments of large river systems with no opportunity for natural recolonization. Existing climate change models suggest increasing temperatures and altered precipitation patterns may substantially impact some populations through altered habitat suitability and increased habitat fragmentation.

NEEDS:

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Research Needs: Continued hybrid and phylogenetic analysis on populations of concern. Determine success of mechanical removal of non-native trout (in terms of removal success and LCT population response) from LCT occupied waters. Determine LCT seasonal movement patterns/preferred habitat in the larger metapopulations/rivers.

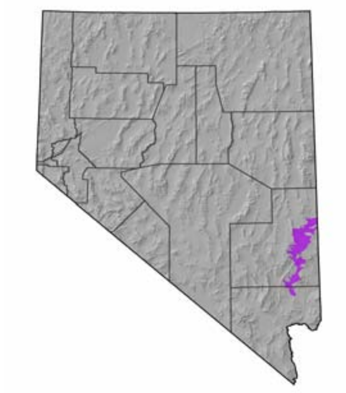
Monitoring and Existing Plans: The LCT is monitored annually, with individual populations on a 3-5 year survey rotation. Existing plans include the LCT SMP for the Upper Humboldt River Drainage Basin, LCT SMP for the Quinn River/Black Rock Basins and the North Fork Little Humboldt River Sub-Basin.

Approach: Rehabilitate streams, construct fish ladders, and restock (Spahr et al. 1991). Use fencing and grazing controls to protect spawning tributaries from sedimentation (Behnke 1992). Identify and coordinate interagency activities to secure, manage, and improve habitat for all existing populations. Develop and implement reintroduction plans, regulate harvest to maintain viable populations, and manage self-sustaining populations existing out of native range until their need is completed (USFWS 1994f).

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Meadow Valley speckled dace *Rhinichthys osculus ssp. 11*

WAP 2012 species due to existing surface water development impacts and habitat alteration.



Agency Status	
NV Natural Heritage	G5T2S2
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Trend appears to be stable.

DISTRIBUTION: Occupies suitable habitat in middle and upper reaches of Meadow Valley Wash, Clover Creek and the Condor Canyon portion of Meadow Valley Wash.

GENERAL HABITAT AND LIFE HISTORY:

Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. Studies on fish movement in Condor Canyon revealed that all native fishes supported greater densities upstream of Delmue Falls, also that Kill Wash supported critical habitat for spawning in the upper canyon section (Jezorek et al 2011).

CONSERVATION CHALLENGES:

Conservation challenges for the Meadow Valley speckled dace include, existing surface water development impacts, habitat alteration, unknown effects from climate change, non-native species, rainbow trout and heavy impacts from crayfish, water diversion, and flood effects in the Meadow Valley Wash populations.

NEEDS:

Research Needs: Further annual surveys are needed to monitor dace distribution and abundance throughout range, particularly upstream from Delmue Road Bridge in Condor Canyon where important native fish habitat exists (Jezorek 2011).

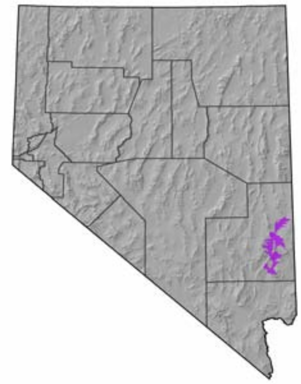
Monitoring and Existing Plans: Meadow Valley Wash RIT was established in 2000, TNC property in Condor Canyon ensures conservation measures appropriate for continued persistence. Co-occurs with Big Spring spinedace in Condor Canyon a USFWS Threatened Species with delineated Critical Habitat. USFWS Recovery Plan (covering Big Spring spinedace) 1993 affords the speckled dace defacto protection for that part of its range. NDOW conducts annual population monitoring.

Approach: Non-native crayfish present the highest threat to the native fish fauna in many parts of their range, particularly in Condor Canyon. Non-native rainbow trout also pose a risk throughout its range.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Meadow Valley Wash desert sucker *Catostomus clarkii ssp. 2*

WAP 2012 species due to existing surface water development impacts and habitat alteration.



Agency Status	
NV Natural Heritage	G3G4T2S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Appears to be stable with isolated populations.

DISTRIBUTION: Known to occur in middle and upper reaches of Meadow Valley Wash, Clover Creek, and Condor Canyon.

GENERAL HABITAT AND LIFE HISTORY:

The Meadow Valley Wash desert sucker occurs in suitable habitat in Meadow Valley Wash, Clover Creek, and portions of Condor Canyon. In Clover Creek and Meadow Valley Wash below the Clover Creek confluence, suitable habitat is dynamic because of frequent flood events and populations can be isolated because of ephemeral summer flows and water diversions. Sucker growth was measured in the Condor Canyon section of Meadow Valley Wash, with lengths ranging from 20-39mm in June. By September and into early October, fork lengths ranged from 31-39 mm. Desert sucker movement was, in one instance, shown to be over 1km in Condor Canyon (Jezorek 2011). Spawning related movement was detected in late March to early May.

CONSERVATION CHALLENGES:

Conservation challenges include, existing surface water development impacts, habitat alteration, unknown effects from climate change, non-native species, particularly crayfish, threats due to railroad activities such as hazardous material spills, floods, and fire.

NEEDS:

Research Needs: Pursue continued efforts at conservation easements, and long term monitoring of existing populations. Explore, survey, and identify native fish habitat in Kill Wash in the upper portion of Condor Canyon.

Monitoring and Existing Plans: Meadow Valley Wash RIT was established in 2000. TNC property in Condor Canyon ensures conservation measures appropriate for continued persistence. Co-occurs with Big Spring spinedace in Condor Canyon a USFWS Threatened Species with delineated Critical Habitat. The USFWS Recovery Plan (covering Big Spring spinedace) 1993 affords the Meadow Valley speckled dace and Meadow Valley Wash desert sucker defacto protection. NDOW conducts annual population monitoring.

Approach: Continue or pursue conservation agreements with Union Pacific Railroad, and directed habitat restoration with NDOT, as Meadow Valley Wash is prone to frequent high intensity flooding.

WAP HABITAT LINKS: Warm Desert Riparian.

Moapa dace *Moapa coriacea*

WAP 2012 species due to its federal endangered status, impacts from exotic invasive species, and threats from groundwater development.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Species has increased since the all-time historic low in 2008, with an increase in numbers over past few years. Dace numbers continue to increase but are still approximately half of pre-2007 numbers.

DISTRIBUTION: Endemic to the warm spring area at headwaters of Muddy River, northern Clark County, southeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Moapa dace are a thermally endemic species, restricted to clear pools and outlet streams of moderate to high temperatures (19.5-33.9°C; 67-93°F) (Lee et al. 1980). Moapa dace inhabit spring pools, spring feeders, small outflow streams, and main river channels, again, usually in warmer waters (28-32°C; 82-89.6°F) (USFWS 1995a). Substrate may be mud, sand, gravel, or pebble. Waters contain abundant algae and are shaded or bordered by mesquite, saltcedar, or fan palm.

Adult diet consists of invertebrates (75%) and plants and detritus (25%) (Scoppettone et al. 1992).

Adults occur near the bottom of the water column, in focal velocities of 0-55 cm/sec (0-1.8 ft/sec). Largest individuals occur in areas with the greatest flow. Juveniles occupy a narrower range of depths and velocities, and larvae occur in slack water (Scoppettone et al. 1992). The Moapa dace spawns in headwater tributaries of the Muddy River, within 150 m (492 ft)of warm water spring discharge in water temperatures of 30-32°C (86-89.6°F) (Scoppettone et al. 1992). It breeds year-round, with the peak in spring and the lowest level in fall. Females sexually mature at 41-45 mm (1.6-1.8 inches) in fork length. Life spans are up to at least 4+ years (Scoppettone et al. 1992).

CONSERVATION CHALLENGES:

Recent studies found this species in low numbers only in restricted portions of 3 springs and in less than 3.2 km (2 miles) of spring outflow and river. Present status is due to loss and alteration of habitat due to groundwater pumping, the introduction of exotic fish (tilapia, shortfin molly) and invasive plants, and the restriction of distribution to small headwater streams. Palm crown fires on Moapa National Wildlife Refuge and other headsprings areas have caused population declines from elevated water temperatures and ash flow, demonstrating its vulnerability to catastrophic events. Tilapia and other invasive plant and animal species continue to be a major concern as is current and future water development; Moapa Dace are the most sensitive to water development of the four Muddy River endemic fish species.

NEEDS:

Research Needs: More research is needed regarding tilapia and other non-native fish interactions, effects of invasive submergent and emergent plants on habitat quality, behavior/migration of riverine versus tributary fish (effects of barriers on population fragmentation and genetic or management strategy to resolve), and minimum flow requirements to maintain habitat quality.

Monitoring and Existing Plans: Dive counts are completed system wide each February and August. There is a need to evaluate use, entrainment, and distribution in agricultural diversions. This species is included in the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Draft Muddy River Recovery Implementation Program (MRRIP) plan.

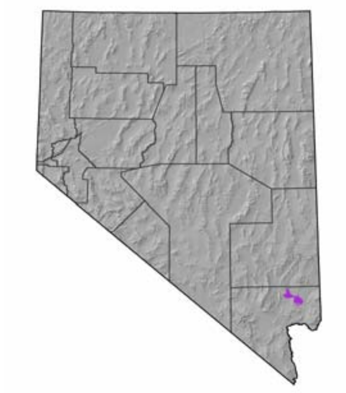
WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Approach: USFWS has acquired key headspring areas as the Moapa National Wildlife Refuge to protect habitat. Several springs with occupied dace habitat now have protected flows. Streams on and immediately below the refuge provide the only remaining spawning habitat (USFWS 1994). SNWA purchase of key northern Muddy Springs area land for conservation purposes will assist in persistence of species. Pattern of habitat use by different life history stages indicates that all remaining habitat is necessary for the survival of this species (Scoppettone et al. 1992). Conservation emphasis is on restoration of spring and outflow habitats, and control and/or eradication of detrimental invasive species. Additional barriers may be needed to continue these eradication efforts downstream in the main Muddy River channel. Additional landowner agreements are needed to protect habitats and gain access for recovery efforts in key habitats. Removal of exotic species from the mainstem Muddy River is essential to allow dace access to those habitats and restoration of full life history functions. The MRRIP Biological Action Committee was established in 2009 to direct and coordinate monitoring, recovery actions, and habitat restoration.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Moapa speckled dace — *Rhinichthys osculus moapae*

WAP 2012 species due to impacts from exotic invasive species.



Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Populations declining.

DISTRIBUTION: Middle Muddy River, Clark County, NV downstream of Warm Springs headwaters.

GENERAL HABITAT AND LIFE HISTORY:

Preferred habitat is flowing main river channel for drift feeding on debris and invertebrates. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals.

CONSERVATION CHALLENGES:

Impacts from tilapia and other invasive aquatic species, groundwater and surface water development, and fragmentation of habitat from dams and diversion.

NEEDS:

Research Needs: Information on life history, habitat requirements, and distribution is needed.

Monitoring and Existing Plans: Muddy River speckled dace are monitored annually using hoop nets and other methods. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Muddy River Recovery Implementation Program (RIP) Implementation Plan. Conservation efforts are identified and implemented through the Muddy River RIP Biological Action Committee.

Approach: Muddy River efforts have emphasized control of invasive tilapia and saltcedar and identification of off-site refuge locations to maintain speckled dace adult populations and genetics.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

Moapa White River springfish *Crenichthys baileyi moapae*

WAP 2012 species due to impacts from exotic invasive species.

Agency Status	
NV Natural Heritage	G2T2S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Endemic to five springs in the upper Muddy River system, Clark County.

GENERAL HABITAT AND LIFE HISTORY:

Moapa White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991).

Moapa White River springfish have evolved to tolerate high water temperatures and low dissolved oxygen levels. In the Muddy River system, this subspecies occupies headwater spring and outflow habitats similar to those used by Moapa dace. Moapa White River springfish spawn in warm summer months. Apparently 10-17 eggs constitute a spawning and eggs are laid and fertilized one at a time. Incubation lasts 5-7 days.

CONSERVATION CHALLENGES:

Within the Muddy River system distribution and numbers appear to have declined significantly since 1980 although good baseline data for comparison of changes is lacking. Much of the species habitat has been lost to groundwater pumping and alteration. In addition, competition for food and predation by non-native fishes continue to threaten the species. Like other Muddy River endemic species, key concerns include habitat degradation, alteration, and fragmentation, competition and predation from nonnative aquatic species including tilapia and mollies. Current and potential future threats from surface and groundwater development are also key concerns. Some key habitats occur on private lands but landowner agreements for protection and long-term security do not include all private land habitats.

NEEDS:

Research Needs: Research is needed regarding tilapia and other non-native fish interactions. Management guidance and requirements for existing and refuge populations are needed.

Monitoring and Existing Plans: Semi-annual monitoring is incorporated into dive counts for Moapa dace where habitats overlap. A more intensive comprehensive range-wide status survey is scheduled every 3 to 4 years. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem. The springfish is an included species in the Muddy River Recovery Implementation Program and implementation plan for the MRRIP.

Approach: Conservation and management for Moapa White River springfish is incorporated into recovery implementation actions for Moapa dace and other upper Muddy River species. Key elements include monitoring, fish eradication projects, fish barriers construction, fish reintroduction, habitat restoration. Private landowner agreements need to be pursued to develop better security for some occupied habitats. The MRRIP Biological Action Committee established in 2009 to direct and coordinate monitoring, recovery actions, and habitat restoration for the upper Muddy River also addresses needs for this species.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Monitor Valley speckled dace *Rhinichthys osculus ssp. 5*

WAP 2012 species due to lack of knowledge about the subspecies, impacts from exotic invasive species and groundwater development, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Two locations in Monitor Valley, Nye County.

GENERAL HABITAT AND LIFE HISTORY:

Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge. The speckled dace eats various small aquatic animals. Specific life history information on speckled dace inhabiting small, isolated spring and outflow habitats is less well understood.

CONSERVATION CHALLENGES:

Conservation issues include non-native species (crayfish), groundwater development, and little current knowledge on status and specific life history requirements.

NEEDS:

Research Needs: Information on life history and habitat requirements is needed.

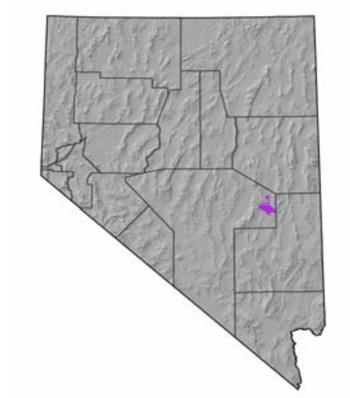
Monitoring and Existing Plans: No specific monitoring currently in place although populations have been monitored occasionally for presence/absence. No species specific planning or applicable plans in place.

Approach: Management approach to be determined.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian, Intermountain Riparian.

Moorman White River springfish *Crenichthys baileyi thermophilus*

WAP 2012 species due to its limited distribution and susceptilbilty to water development.



Agency Status	
NV Natural Heritage	G2T1S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend is unknown, but appears stable.

DISTRIBUTION: Endemic to three thermal spring systems in upper White River Valley, Nye County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Moorman White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991). They are able to survive extremes in temperature and dissolved oxygen. Temperature and minimum oxygen values vary considerably among spring habitats, from 31°C (87.8°F) and 6.6 ppm oxygen at Moon River Spring to 37°C (98.6°F) at Moorman Spring. The Moorman White River springfish spawns in warm summer months. Apparently 10-17 eggs constitute a spawning. Eggs are laid and fertilized one at a time. Incubation lasts 5-7 days. This subspecies occupies the warmest headwater spring habitats of any White River springfish, and utilizes outflow/springbrook habitats downstream to the lower limit of thermal tolerance.

CONSERVATION CHALLENGES:

Distribution is limited to three spring and outflow habitats in White River Valley, only one of which is secure under public control (Kirch WMA). Although populations in private lands habitats are relatively stable they do not have agreements or easements in place to provide long term security and protection. All occupied habitat have some level of degradation and alteration and competition from introduced species. Introduced nonnative predators have been a periodic problem at Hot Creek (Kirch WMA) due to illegal introductions. Potential threats exist from proposed groundwater development actions.

NEEDS:

Research Needs: Habitat preference/requirements, genetic management of isolated populations, impacts of crayfish introduction and control strategies should be studied.

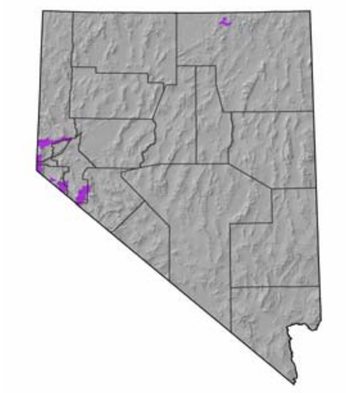
Monitoring and Existing Plans: Biennial or annual status monitoring is completed by NDOW depending on the location. The Moorman White River springfish is included in the White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure long-term protection and management of occupied habitats. NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Springs and Springbrooks, Marshes, Lakes and Reservoirs.

mountain whitefish — *Prosopium williamsoni*

WAP 2012 species due to habitat degradation and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Unknown trend, however low numbers generally turn up in many surveys in comparison to other stream fishes, indicating a potential decline (Lawrence and Seiler 2002).

DISTRIBUTION: Known populations are restricted to larger Sierra front streams (Truckee, Walker, and Carson). Limited distribution in the Carson River, where suitable habitat runs out near Minden. Also occurs in the Jarbidge, Bruneau, and South Fork and East Fork Owyhee Rivers.

GENERAL HABITAT AND LIFE HISTORY:

Lahontan Basin whitefish are morphologically conserved throughout its range, and its distribution is geographically limited by water temperatures and salinity (Whiteley et al 2006). Fish require streams with a minimum pool depth of 4 feet in season of least flow. They feed primarily on insects and tend to live in cold water in larger streams and rivers. Spawning time depends on the latitude and temperature of the stream or river, but it is usually between October and December in riffles (Sigler and Sigler 1987). The average length of mountain whitefish is 23-30 cm (9-12 inches; Behnke 2002).

CONSERVATION CHALLENGES:

Under current conditions, spawning, incubation, and rearing habitat for native mountain whitefish and non-native brown and rainbow trout in Donner and Prosser Creeks and the Little Truckee River is relatively degraded and reduced in extent compared to historic conditions (CDFG 1996). In the Truckee River, spawning and fry rearing habitat also is degraded, and many of the complex pool habitats critical to juvenile survival have been lost. In the upper Truckee drainage it was found that after the construction of upstream water storage dams, the populations of whitefish in Sagehen and Prosser Creeks severely declined (Moyle 2002).

NEEDS:

Research Needs: Mountain whitefish specific surveys need to be conducted, particularly on the Walker and Carson Rivers. Whitefish numbers and abundance do not appear strong in comparison to other fishes during surveys.

Monitoring and Existing Plans: Unknown if there are any specific conservation plans or actions for mountain whitefish.

Approach: Protection of larger pools, particularly in the low flow seasonal months and a minimum instream flow throughout the year to provide suitable habitat is needed. Flow regimes selected in the Truckee River have generally been based on the needs of non-native brown and rainbow trout.

WAP HABITAT LINKS: Intermountain Riparian.

Oasis Valley speckled dace *Rhinichthys osculus ssp. 6*

WAP 2012 species due to threats from exotic invasive species and groundwater development, habitat alteration, and habitat fragmentation.

Agency Status	
NV Natural Heritage	G5T1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Limited populations exist in a few springs and outflows including portions of the Amargosa River within Oasis Valley.

GENERAL HABITAT AND LIFE HISTORY:

The Oasis Valley speckled dace has highly isolated populations throughout Oasis Valley with minimal connectivity. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise. A high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Small local populations are vulnerable to habitat alteration and exotic species. Reasons for decline include dewatering of springs, headwaters, and middle portions of major streams, water impoundment, channelization, diversion, regulation of discharges, and interactions with non-native species particularly crayfish and bullfrogs (Minckley 1985, Moyle et al. 1989). See Taylor et al. (1989) for information on negative impact of cattle on desert spring populations (chemical alteration of water).

NEEDS:

Research Needs: Continued efforts to inventory all potential waters capable of containing speckled dace are needed.

Monitoring and Existing Plans: Annual monitoring is conducted by NDOW. Amargosa Toad Working Group, Beatty Habitat Committee, and Storm-OV have contributed to multiple conservation efforts to secure toad habitat which indirectly provides security for speckled dace. TNC properties have on-going restoration efforts. Bi-annual NDOW surveys of known populations. There are continuing efforts to obtain private lands for habitat enhancement and private landowner access (USFWS Partners and NDOW LIP Programs).

Approach: Continued efforts to secure dace habitat throughout Oasis Valley, continued crayfish and bullfrog eradication efforts are needed. Landowner and conservation agreements to further improve and secure habitat.

WAP HABITAT LINKS: Springs and Springbrooks.

Pahranagat roundtail chub *Gila robusta jordani*

WAP 2012 species due to its federal endangered status, population declines, habitat alteration, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G3T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is declining; possibly extinct in the wild.

DISTRIBUTION: Historically thought to occur in outflows of thermal springs in Pahranagat Valley including Ash, Crystal, and Hiko Springs as well as the Pahranagat River. The only wild population is currently restricted to a single spring outflow in Pahranagat Valley, Lincoln County, NV. Refugium populations exist at Dexter National Fish Hatchery, an artificial pond at Key Pitman State Wildlife Management Area, and a pond on Pahranagat NWR.

GENERAL HABITAT AND LIFE HISTORY:

Current known distribution of the Pahranagat roundtail chub in the wild is limited to an approximately 3/4-mile reach of the Pahranagat River (Ditch) below the Ash Springs outflow on private property. It has not been observed in either Crystal or Hiko springs since the early 1950s, and suitable lotic habitats at both those locations have been severely reduced or eliminated. Presumed distribution within the Pahranagat River (Ditch) is reduced from that found historically because much of the former river channel has been lined with concrete to facilitate irrigation, or lost as a result of agricultural development. It is thought to seek thermal refuge closer to the thermophilic outflows during winter, but spawns in the cooler portions of the outflows in late spring. They are omnivores, feeding mostly on aquatic insects with larger adult occasionally feeding on smaller fishes and other aquatic vertebrates.

Pahranagat roundtail chub primarily eat drifting invertebrates, but also occasionally consume food off the bottom. They eat some plant material and rarely eat other fish.

Spawning typically occurs in late January and peaks in early to mid-February. Water temperatures during this period range from 17-24°C (63-76°F). Areas up to 3 feet deep with gravel substrate and relatively swift flows are used. Each spawning female may be attended by a group of 2-10 males. Spawning occurs intermittently over several days. The eggs are broadcast and drop into spaces between the rocks. Larvae swim-up in approximately 28 days. They likely live from 3-5 years.

CONSERVATION CHALLENGES:

This subspecies is restricted in distribution in the wild to a single location on private land. Access for monitoring has been infrequent. A 2010 survey revealed only 2 fish, both young adults in the 1 to 2 year old range, indicating that successful reproduction has recently occurred. Managed refuge populations exist on public land in Pahranagat Valley and at Dexter NFH, New Mexico. Historically occurred in outflow systems at Hiko and Crystal springs prior to their alteration. Downstream alterations of existing habitats have restricted available habitat and distribution in the Ash Spring outflow system. Thermal loading from spring discharge in summer months impacts habitat suitability. Existing agricultural practices have likely negative effects on flows and temperatures in occupied habitat. Also, competition exists from nonnative species including mollies and cichlids, in addition, there are potential threats from proposed future groundwater development.

NEEDS:

Research Needs: Taxonomic status needs to be clarified. Additional life history and habitat relationship information is needed to assist in restoration of historic unoccupied habitats.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

Monitoring and Existing Plans: Monitoring was conducted semiannually until 2001. Since then, access from landowner has been infrequent and surveys were conducted in 2006, when a few adults and juvenile fish were observed, and in 2011, when only 8 adult fish were observed. To prevent extinction of the species, two refuge populations have been created on public lands in the native range of the Pahranagat Valley. The Pahranagat roundtail chub is included in the Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley (FWS 1998) and the Pahranagat Valley Native Fishes Management Plan (NDOW 2000b).

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. RIT team implements Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals/objectives/actions. Refuge populations were established at Key Pitman WMA in Pahranagat Valley in 2004 and on Pahranagat NWR in 2011 using captive fish from Dexter NFH. Priority actions include development of agreements with landowners to gain access to the existing wild population and allow restoration of historic unoccupied habitats.

WAP HABITAT LINKS: Springs and Springbrooks, Warm Desert Riparian.

Pahranagat speckled dace *Rhinichthys osculus velifer*

WAP 2012 species due to limited distribution and endemism.

Agency Status	
NV Natural Heritage	G5T1QS1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
CCVI	Presumed Stable

TREND: Declining from historic range. Pahranagat speckled dace have been recently reintroduced to spring systems in Pahranagat Valley.

DISTRIBUTION: Restricted to a few spring systems in the Pahranagat Valley, NV.

GENERAL HABITAT AND LIFE HISTORY:

This subspecies has been identified as one of the"Swift-morph" of the speckled dace complex, with the body form being more terete and slender (Gilbert 1893). Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, and intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age three. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Pahranagat speckled dace are a narrowly endemic subspecies restricted to a few springs in the lower White River in the Pahranagat Valley. Highly susceptible to predation from invasive bass and sunfish. Other potential anthropogenic factors such as groundwater withdraws, water diversions and drought can significantly reduce habitat and population numbers.

NEEDS:

Research Needs: In the pluvial Pahranagat River, one or more unnamed "chubby-bodied" dace, possessing unique fin morphology, have been reported (LaRivers 1962). These populations warrant more attention.

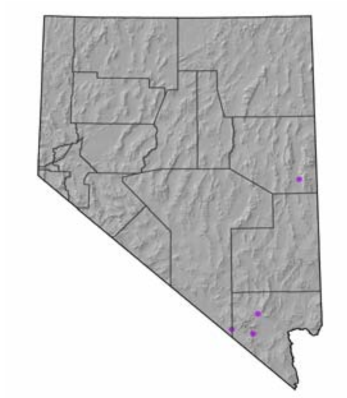
Monitoring and Existing Plans: Active conservation is currently in progress on Pahranagat NWR to restore habitat and re-establish populations of this species. Annual or semi-annual surveys are conducted by NDOW. The Pahranagat Valley Native Fishes RIT includes this species in conservation planning.

Approach: Restore and actively manage existing populations and habitats including eradication of invasive species. Only one or two natural populations remain. Continue active conservation on Pahranagat NWR and other suitable locations in Pahranagat Valley to develop and re-establish populations in its range.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks.

Pahrump poolfish *Empetrichthys latos latos*

WAP 2012 species due to its federal endangered status, limited distribution, threats from groundwater development, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	
USFWS	No Status

TREND: Of the three extant refuge populations, two remain stable and the third (Corn Cr. Springs) remains below 200 fish.

DISTRIBUTION: Introduced populations now exist at three refuge sites in Clark and White Pine counties. They are extirpated from native range in three springs in Pahrump Valley, NV and now exist only outside the Pahrump Valley (Page and Burr 1991).

GENERAL HABITAT AND LIFE HISTORY:

Pahrump poolfish inhabit shallow warm springs (Lee et al. 1980), including alkaline mineral springs and outflow streams (Matthews and Moseley 1990). In their natural habitat, larger individuals frequented more open deeper waters, while young were in shallower more weedy areas (Kobetich et al. 1980).

Pahrump poolfish are described as omnivorous, apparently feeding on a wide variety of available plant and animal material (Kobetich et al. 1980).

Females move to remote areas of springs during the breeding periods (Kobetich et al. 1980). Pahrump poolfish apparently spawn at any time of year, but spawning activities peak in the spring (probably March-April). In transplanted populations young appear more active during the day, adults appear more active at night (Kobetich et al. 1980). They are inactive in winter and early spring (USFWS 1993b). These fish were originally restricted to three separate springs in Pahrump Valley, southern Nye County, NV. They are now extirpated from native range in those three springs and now exist only outside the Pahrump Valley (Page and Burr 1991). They formerly occurred in Raycraft Ranch Spring (ssp. concavus) and Pahrump Springs (ssp. pahrump). E. l. latos is extirpated from its native habitat at Manse Ranch Spring (dewatered). Transplanted populations of subspecies latos occur at three locations: Corn Creek Springs on the Desert National Wildlife Refuge, Clark County; Shoshone Springs (Ponds), Spring Valley, White Pine County (on BLMs Shoshone Ponds Natural Area), and an irrigation reservoir, fed by Sandstone Spring, at Spring Mountain State Park, Clark County (Minckley et al. 1991, USFWS 1993b). All are on public lands.

CONSERVATION CHALLENGES:

The Pahrump Ranch poolfish (E. l. pahrump) and Raycraft Ranch poolfish (E. l. concavus) subspecies are now extinct due to desiccation of their native springs from groundwater pumping and modifications to springheads. Pahrump poolfish (E. latos) was extirpated from its natural, native habitat due to the desiccation of the springs as a result of groundwater pumping for irrigation. They now occur only in refugium populations located on public lands. The three extant refuge populations are relatively secure but could be threatened by proposed groundwater development actions at Corn Creek Springs and Shoshone Ponds. Additional concerns include predation and competition from exotic fishes and amphibians and encroachment of vegetation at Spring Mountain Ranch and Shoshone Ponds. The potential to re-establish this species within its native range is limited due to the loss or severe alteration of all historic habitats in Pahrump Valley.

NEEDS:

Research Needs: Additional life history information is needed to assist in management of refuge environments.

Monitoring and Existing Plans: Population and status monitoring is completed annually by NDOW at all three locations. Existing plans include, the Recovery Plan Pahrump Killifish and the Spring Mountain Ranch HCP. A RIT Team was established in 2009 and a genetic management plan is proposed.

WAP HABITAT LINKS: Springs and Springbrooks.

Approach: The Corn Creek refuge was reconstructed in 2003 and is managed jointly by NDOW and USFWS. Genetic management protocols have been developed and implemented for the three refuge sites. Management emphasis at the Spring Mountain Ranch and Shoshone Ponds sites is on monitoring for and control of introduced competitors and predators, and actions to insure long-term maintenance of aquatic habitat quality. Research is currently funded to develop more formal refuge and genetic management strategies.

WAP HABITAT LINKS: Springs and Springbrooks.

Preston White River springfish *Crenichthys baileyi albivallis*

WAP 2012 species due to population loss and threats from water development and exotic invasive species.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Restricted to thermal spring systems in upper White River Valley, White Pine County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Preston White River springfish inhabit vegetated warm springs and their outflows and marshes (Minckley et al. 1991).

The Preston White River springfish is able to survive extremes in temperature and dissolved oxygen. Temperature and minimum oxygen values vary considerably among spring habitats. Preston Big Spring has been measured at 21°C (69.8° F) and 3.3 ppm oxygen. It spawns in warm summer months. Apparently 10-17 eggs constitute a spawning and eggs are laid and fertilized one at a time. Incubation lasts 5-7 days. This subspecies occupies the coolest headwater spring and outflow/springbrook habitats of any of the White River springfish.

CONSERVATION CHALLENGES:

Distribution and abundance of this subspecies have declined since 1981 and it now occurs in only 4 of 6 spring systems where it historically occurred. The range-wide total population was estimated at <5,000 individuals in 1999 (Scoppettone and Rissler 2002). Primary impacts have been from alteration, fragmentation and loss of spring and outflow habitats, loss of connectivity between these habitats, and the introduction of nonnative competitors and predators. Potential future threats exist from proposed ground and surface water development projects. The majority of locations for this subspecies are on private lands with restricted access which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Mechanisms for restoring historic habitat while meeting existing water delivery needs and protecting existing populations need to be researched and implemented using an adaptive management approach.

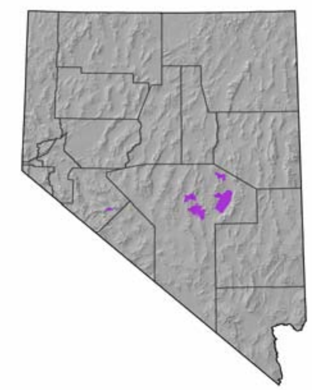
Monitoring and Existing Plans: Semi-annual monitoring is conducted at Indian Spring and other locations are monitored bi-annually where access permission can be obtained. Existing plans are the White River Native Fishes Management Plan and the Indian Spring CCAA.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure access to all extant populations and long-term protection and management of occupied habitats. A more comprehensive scheduled monitoring strategy is needed to gauge success of conservation efforts (Scoppettone and Rissler 2002). NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Springs and Springbrooks.

Railroad Valley springfish *Crenichthys nevadae*

WAP 2012 species due to its federal threatened status, limited distribution, habitat fragmentation, and threats from water development and exotic invasive species.



Agency Status	
NV Natural Heritage	G2S2
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Threatened Fish NAC 503.065.3
CCVI	Presumed Stable

TREND: Stable except for Big Warm Spring population.

DISTRIBUTION: Endemic to thermal springs and outflows in Railroad Valley, Nye County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Railroad Valley springfish inhabit warm spring pools, outflow streams, and adjacent marshes. They are able to tolerate high temperatures and low dissolved oxygen. Duckwater and Lockes Ranch springs have outflow temperatures of 32.3 and 37.3°C and minimum oxygen concentrations of 0.5 and 0.9 ppm, respectively (Lee et al. 1980).

Diet predominantly consists of invertebrates in Railroad Valley, with gastropods most important in June. These fish also eat substantial amounts of plant material, especially filamentous algae (Sigler and Sigler 1987).

Historically occurred in four springs (Big, North, Hay Corral, and Reynolds) near Lockes Ranch and two springs (Big Warm and Little Warm) on the Duckwater Shoshone Indian Reservation, and in the outflow systems associated with these spring complexes. The Big Warm Spring population has been recently extirpated but efforts are currently underway to re-establish it. Three introduced populations occur in Nye and Mineral counties outside of historic range but are not actively managed as species refuges.

CONSERVATION CHALLENGES:

All Railroad Valley springfish habitats have been altered from historic condition to some degree by ditching, diversion, impoundment and other modifications. At Duckwater, extensive populations of non-native fishes including catfish and tilapia in Big Warm Spring, in combination with physical modifications, resulted in the extirpation of springfish at that site. Existing and potential future threats exist at all locations from water diversions, habitat alteration, proposed groundwater development projects, and oil exploration.

NEEDS:

Research Needs: Additional life history and habitat requirements information is needed to assist in the development of habitat restoration strategies.

Monitoring and Existing Plans: Annual monitoring is conducted at all Railroad Valley sites by NDOW, and at Duckwater in cooperation with the Duckwater Tribe and the USFWS. The Railroad Valley springfish is included in the Railroad Valley Springfish Recovery Plan.

Approach: Conservation actions are reviewed and implemented through the Railroad Valley Fishes RIT which meets semiannually. At Duckwater sites, actions to restore the Big Warm Spring site including removal of non-native fishes and restoration of the spring and outflow have been completed by the Duckwater Tribe, NDOW, USFWS, and other cooperators. Additional restoration is ongoing at Little Warm Spring. For Lockes Ranch occupied habitats, the private lands containing the majority of springfish habitats have been acquired by NDOW (in 2005) and initial restoration efforts have been completed including restoration of degraded and altered spring outflow systems. Cooperative maintenance and habitat quality monitoring at North Spring (headspring) is completed annually in coordination with BLM.

WAP HABITAT LINKS: Springs and Springbrooks.

razorback sucker *Xyrauchen texanus*

WAP 2012 species due to its federal endangered status, altered habitats, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
USFS-R4	Endangered
State Prot	Endangered Fish NAC 503.065.2
CCVI	Increase Likely

TREND: Declining (USFWS 1997b). See Minckley et al. (1991) and USFWS (1997b) for a detailed account of the historical status, decline, present status, and threats. See Marsh and Minckley (1989) for a discussion of status in the lower Colorado River.

DISTRIBUTION: A Colorado River endemic. Largest extant population occurs in Lake Mohave, AZ/NV. In NV small populations also occur in Lake Mead and the Colorado River below Davis Dam.

GENERAL HABITAT AND LIFE HISTORY:

The razorback sucker is found in the main stream of the Colorado River and large tributaries. Habitats include slow areas, backwaters, and eddies of medium to large rivers and their impoundments (3 of the 4 remaining populations of greater than 100 individuals are in reservoirs). This fish is often associated with sand, mud, and rock substrate in areas with sparse aquatic vegetation, where temperatures are moderate to warm (Sigler and Miller 1963). Limited data indicate that young tend to remain along shorelines, in embayments along sandbars, or in tributary mouths (see Minckley et al. 1991). In Lake Mohave, individuals were associated with inshore habitats except during the hotter months when they moved offshore possibly to avoid warmer water temperatures (Mueller et al. 2000). Spawning occurs most commonly near shore in streams over silty sand, gravel, or rock substrate at depths of up to about 6 meters (often in water less than 0.6 meter deep). Known and suspected spawning sites in the Green and other upper-basin rivers all are in broad, flat-water segments (Minckley et al. 1991). Ripe individuals often have been taken over or near coarse sand, or gravel or cobble bars, in flowing water. In reservoirs, spawning occurs on gravel bars swept clean by wave action, and also along shorelines over mixed substrates ranging from silt to cobble (USFWS 1994b). Spawning has been observed downstream from major impoundments, below Davis Dam and Hoover Dam (Mueller 1989). Larvae appear to remain in gravel until swim-up (USFWS 1990a). Apparently they prefer the shallow littoral zone for a few weeks after hatching, then disperse to deeper waters (USFWS 1994b). Seasonally inundated flood plains provide favorable feeding areas for young.

The razorback sucker is a planktivorous and benthic feeder, eating algae, planktonic crustaceans, and aquatic insect larvae. In Lake Mohave, Arizona-Nevada, diet of adults was dominated by planktonic crustaceans, diatoms, filamentous algae, and detritus (Marsh 1987).

In Lake Mead at least three sub-populations exist all associated with reservoir inflow areas. The Lake Mead population likely comprises less than 2,000 adult fish but this is the only wild population of the species known to show consistent and substantial successful natural recruitment. Reasons for this are not fully understood but might be associated with seasonal turbidity or other reservoir physical characteristics (Shattuck et al 2011). Recaptures and radio-tracking indicate that individuals may remain in one area (a few km long) for several months (USFWS 1990a), but individuals may move 100-200 km or or more over several years (Wick et al. 1982). In Lake Mohave, linear range lengths of 10 adults over 14 months were 18-72 km (mean 39 km) (Mueller et al. 2000). The razorback sucker usually swims in schools.

CONSERVATION CHALLENGES:

WAP HABITAT LINKS: Warm Desert Riparian, Lakes and Reservoirs.

Successful recruitment is low or absent across much of occupied range despite successful spawning and larval emergence. Impoundment of Colorado River reservoirs has fragmented range and altered habitats and water quality. Remaining river has been affected by altered flow regimes and disconnection from historic backwater and seasonal floodplain habitats due to entrainment and channelization. With the exception of limited evidence from Lake Mead NV/AZ, essentially no recruitment to reservoir populations has been detected since 1963 in the lower Colorado River basin. Other problems include competition and predation on larvae and juveniles by introduced fishes and crayfish, which thrive in altered habitats (USFWS 1990a; Lenon et al. 2002), paucity of spawning adults, and hybridization with other suckers (Tyus and Karp 1990, Minckley et al. 1991). See USFWS (1990a) for many details on habitat changes that have affected this species.

NEEDS:

Research Needs: Habitat relationships and habitat utilization in impoundments, culture methods, interspecific interactions with other native and game fish species, habitat restoration strategies and methods, techniques for effective control of nonnative competitors and predators, and specific research efforts on Lake Mead to determine factors responsible for limited natural recruitment in the wild, are all areas for research.

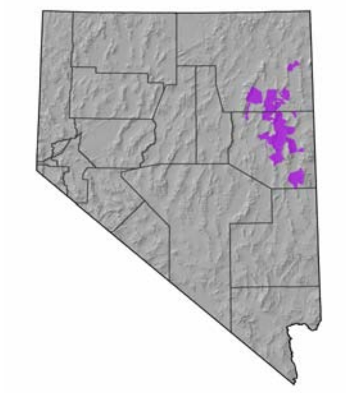
Monitoring and Existing Plans: Lake Mohave monitoring is conducted semiannually by the cooperative Native Fish Work Group including NDOW and AGFD, while USBR/USGS conduct monitoring below Davis Dam. Lake Mead annual monitoring is conducted primarily by BIO/WEST (contractor to USBR) with assistance by NDOW and other agencies. Plans include the Lower Colorado River MSCP, Razorback Sucker Recovery Plan & Recovery Goals Addendum, Lower Colorado River Basin Native Fish Management Strategy, and the Management Plan for the Big River Fishes of the Colorado River Basin.

Approach: In the lower basin mainstem Colorado River basin where opportunities for habitat and flow restoration are limited, efforts for razorback sucker conservation are focused on maintenance and re-establishment of persistent adult populations in mainstem reservoirs, and riverine habitats where available, primarily using wild-caught larvae to produce large juvenile (>300mm) fish for release to the wild. The future potential for re-establishing wild reproducing populations is largely dependent on limited areas where seasonal floodplain habitats and flow regimes can be reconstructed to some degree, integrating some level of control on nonnative predators and competitors, primarily in relic mainstem riverine areas and tributaries. Some limited success has been demonstrated in establishing offchannel refuge populations in ponds and wetlands (Mueller et al 2004) and in using seasonally connected wetlands and backwaters to "head-start" sub-adult fish (Wydoski and Wick 1998). In Lake Mead NV, evidence that limited wild recruitment is occurring (Welker and Holden 2004) may indicate some potential to further develop persistent wild stocks there or in other Colorado River reservoirs. Conservation strategies for Nevada razorback sucker habitats are being implemented by the Lower Colorado River MSCP program, the Native Fish Work Group, and the Lake Mead Razorback Sucker Work Group to all of which NDOW is a cooperator; Recovery and conservation strategies for this species are outlined in the species recovery goals (USFWS 2002b) and Lower Colorado River Basin native fish management plan (USFWS 2005).

WAP HABITAT LINKS: Warm Desert Riparian, Lakes and Reservoirs.

relict dace *Relictus solitarius*

WAP 2012 species due to threats from groundwater development, habitat alteration, nonnative species introducions, and climate change.



Agency Status	
NV Natural Heritage	G2G3S2S3
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067
IUCN	Endangered
CCVI	Moderately Vulnerable

TREND: Most populations are stable.

DISTRIBUTION: Multiple locations in Spring, Steptoe, Ruby, Butte, and Goshute valleys, east-central Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Relict dace are a unique genus of endemic cyprinid minnow occurring only in several isolated basin valleys in east-central Nevada. Occupied habitats are springs, spring-fed streams, ponds, intermittent lakes and marshes, with mud or stone bottoms. Typically concentrates in well-vegetated pools where banks are undercut. Relict dace are midwater swimmers taking cover in soft bottom or vegetation (Sigler and Sigler 1987).

Knowledge on the life history and behavioral characteristics of the species is limited. Like other cyprinids, relict dace appear to be opportunistic omnivores. Common food items include amphipods, gastropods, insects, ostrocods, and leeches. Size varies tremendously among different populations. Environmental conditions may affect growth and size of fish in localized populations but adults are typically 60mm to 100mm SL. The relict dace is an extremely prolific fish that has a long breeding season, extending from late-June to late-September. Reproductive strategies likely vary with respect to environment, especially thermal regime. Both sexes likely spawn as yearlings with the smallest yearlings spawning in their second year of life. In addition, many females reproduce when 2+ years old while few males breed at ages older than 1 or 2. Fecundity as well as spawning behavior of the species remains unknown. It is speculated that the fish are vegetative broadcast spawners since soft mud substrates typical to relict dace habitats are often anaerobic. The relict dace is a highly secretive species. When held in laboratory tanks, the species spend most of its time hiding. In a natural environment, it is a mid-water swimmer that is seldom observed at the surface or resting on the bottom. This may be in response to potential predators such as birds. When alarmed, however, the relict dace is known to dive into the soft mud substrate or submerged vegetation of its habitat. Vegetation is a key component of the relict dace's habitat. Heavy growth of <i>Chara</i>, <i>Nasturtium</i>, <i>Potamogeton</i>, <i>Utricularia</i>, filamentous algae, rush (bull and spike), moss, and <i>Carex</i> are characteristic of relict dace habitats (Crookshanks 2006; Hubbs and Miller 1975; Sigler and Sigler 1987).

CONSERVATION CHALLENGES:

Although relict dace occur at multiple locations, all populations are isolated except within larger spring complex systems. Many sites are on private lands and do not have agreements in place to insure persistence and prevent alteration. Several sites have been impacted by the introduction of warm-water and cold-water game fish species, and sites in Spring and Goshute valleys are subject to future threats from surface and groundwater development. Spring Valley is likely not within the historic distribution of the species and all extant Spring Valley populations are introduced, but those sites represent important conservation for the species. Occupied sites not associated with deep carbonate aquifer flow sources may be particularly threatened by future climate change scenarios.

NEEDS:

Research Needs: Additional information on life history and habitat requirements; impacts of flow changes on habitat availability and suitability are needed.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Marshes.

Monitoring and Existing Plans: A sub-set of relict dace populations in Spring Valley are included in the Biological Monitoring Plan for the Spring Valley Stipulation (BWG 2009) but no comprehensive monitoring or management plan exists for the species range-wide. Annual monitoring is conducted for populations included in the BWG plan but other populations are monitored only on a biennial or less frequent basis. The most recent range-wide assessment of the species was completed in 2006 (Crookshanks 2006).

Approach: Monitoring will be continued at least annually at sites included within the Spring Valley Stipulation monitoring requirements. Although annual monitoring is likely not needed for all populations, a comprehensive management strategy and plan should be developed to insure periodic monitoring of isolated populations and the persistence of the species across its range. A mechanism is needed to cooperatively protect important populations on private lands to prevent their future loss or alteration.

WAP HABITAT LINKS: Springs and Springbrooks, Intermountain Riparian, Marshes.

Virgin River chub *Gila seminuda*

WAP 2012 species due to its federal endangered status, degraded habitat quality, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Population declining.

DISTRIBUTION: In NV, the Virgin River chub historically occupied all of the Virgin River to its confluence with the Colorado River. Current occupancy includes 80 km of the Virgin River's main river channel at and above Mesquite NV, with only occasional occurrence below that point. Chub are rare in NV reaches of the Virgin River but occur with increased frequency upstream in AZ and UT reaches.

GENERAL HABITAT AND LIFE HISTORY:

The Virgin River chub prefers rocky runs, rapids, and pools. It is most common in deeper areas where waters are swift but not turbulent and generally associated with boulders or other cover.

Virgin River chub feed mainly on debris and chironomids in February; cladophora and debris in June; debris, spirogyra, and cladophora in September; and unidentified drift animals, dragonfly larvae, debris, and cladophora in December. Young feed almost exclusively on macroinvertebrates whereas adults (>110 mm TL) feed almost entirely on algae and debris (Greger and Deacon 1988). Cross (1978) found that the diet was up to 90% algae.

Eggs possibly may be laid in gravel or cobble substrates of pools or moderate velocity runs (Sublette et al. 1990). The Virgin River chub spawns late spring to early summer. Eggs hatch in 4-7 days at 19° C (66° F).

CONSERVATION CHALLENGES:

Virgin River chub distribution and abundance has declined severely in the Virgin and Muddy rivers since at least the 1970s. On the Virgin River recent drought conditions and invasive saltcedar have altered aquatic habitats, but a major element in the decline of the Virgin River population has been introduced red shiner (Cyprinella lutrensis) and tilapia (Tilapia aurea). River modifications, including diversions and channelization, have fragmented habitats and directly altered aquatic habitat quality. Additional potential stressors include further habitat alteration, disease, Virgin spinedace (Lepidomeda mollispinis mollispinis) competition with or predation by introduced species, and groundwater and surface water development actions.

NEEDS:

Research Needs: Life history, distribution, recruitment, effect of agricultural diversions, non-native fish impacts and control strategies, efficacy of and strategy for population augmentations are all areas for research. Monitoring protocols (partially completed) are also needed.

Monitoring and Existing Plans: Semi-annual monitoring is conducted in the Virgin River in conjunction with the Lower Virgin River Recovery Implementation Team (RIT) and by NDOW and SNWA contractors. Existing plans include the Virgin River Fishes Recovery Plan, Draft Lower Virgin River Recovery Implementation Strategy, and Virgin River HCRP draft program plan.

Approach: Virgin River conservation activities are implemented by the Lower Virgin River RIT, under the guidance of the Virgin River Fishes Recovery Plan (USFWS 1995b). Current efforts are focused on control and containment of nonnative fishes, primarily red shiner and tilapia, restoration of habitat including control of saltcedar and other invasive plants which alter and stabilize river habitats, maintaining flows and water quality, and stocking of cultured sub-adult fish to re-establish population numbers. The Virgin River HCRP is currently under development and may provide additional resources for conservation efforts for this species.

WAP HABITAT LINKS: Warm Desert Riparian.

Virgin River chub (Muddy River pop.) *Gila seminuda pop. 2*

WAP 2012 species due to its federal endangered status, degraded habitat quality, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G1T1QS1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Fish NAC 503.067

TREND: Population declining.

DISTRIBUTION: Generally found from the Paiute Diversion to Wells Siding Diversion, middle Muddy River.

GENERAL HABITAT AND LIFE HISTORY:

Virgin River chub are most often associated with deep runs or pool habitats of slow to moderate velocities, with large boulders or instream cover such as root snags. Larger adults are often collected in deeper pool habitats. Adults prefer temperatures that are approximately 24°C.

Virgin River chub are omnivorous showing considerable dietary shifts with age. They feed on debris and chironomids and other macroinvertebrates in the drift. Adults feed almost exclusively on algae and debris, up to 90% filamentous algae.

Scoppettone et al. (1996), determined the downstream distribution of native fishes of the Muddy River and its five spring-fed tributaries (Warm Springs area). Approximately 15,600 Virgin River chub were determined to be in the Warm Springs area and up to 17.1 km downstream. More recent distribution and numbers are significantly reduced with chub absent from the Warm Springs area and rare below the Wells Siding Diversion (Scoppettone et al 1999; Shattuck et al 2012). Originally thought to be a separate subspecies, Muddy River chub have been identified as Virgin River chub through recent genetic analyses (USFWS 2008b).

CONSERVATION CHALLENGES:

Observed declines of the Muddy River population may be related to cumulative effects of parasitism, changes in flow, water quality, and substrate, channelization, and the establishment of non-native fish species (USFWS, Federal Register, 24 July 1995). More recently both crayfish (Procambaris clarki) and red shiner (Cyprinella lutrensis) have become established in the middle Muddy River within the range currently occupied by chub (Shattuck et al. 2012).

NEEDS:

Research Needs: Life history, distribution, recruitment, effect of agricultural diversions, non-native fish impacts and control strategies, and efficacy of and strategy for population augmentations are all areas for research. Monitoring protocols (partially completed) are also needed.

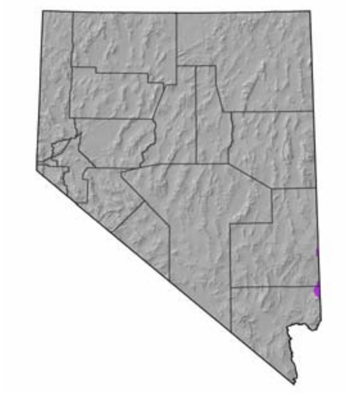
Monitoring and Existing Plans: Muddy River chub are monitored annually using hoop nets and other methods. Existing plans include the Recovery Plan for the Rare Aquatic Species of the Muddy River Ecosystem and the Muddy River Recovery Implementation Program (RIP) Implementation Plan. Conservation efforts are identified and implemented through the Muddy River RIP Biological Action Committee.

Approach: Muddy River efforts have emphasized control of invasive tilapia and saltcedar and development of off-site refuge locations to maintain chub adult populations and genetics.

WAP HABITAT LINKS: Warm Desert Riparian.

Virgin River spinedace *Lepidomeda mollispinis mollispinis*

WAP 2012 species due to habitat degradation, habitat fragmentation, and water diversion.



Agency Status	
NV Natural Heritage	G2T2S1
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Presumed Stable

TREND: Trend stable or increasing.

DISTRIBUTION: Tributary streams of the Virgin River basin and rarely in the mainstem Virgin River. In NV, occurs only in Beaver Dam Wash, Lincoln County.

GENERAL HABITAT AND LIFE HISTORY:

This species is most often found in rocky riffles, runs, and pools associated with headwaters (springs), creeks, and small rivers. It prefers water temperatures from 9-11°C (48-52°F). The Virgin River spinedace is usually found in shaded pools (0.5-2.0 m (1.6-6.6 ft) deep), but can also be found in runs (e.g., at Beaver Dam Wash) and in shear zones between high and low velocities with cover such as boulders, undercut banks, or vegetation. Occasionally is found in riffles in winter (Angradi et al. 1991).

The Virgin River spinedace is an opportunistic feeder. It feeds seasonally on aquatic and terrestrial insects, insect larvae, and floating plant material. It feeds at or near the surface of the water (Minckley 1973), but reportedly also feeds on the bottom. In Beaver Dam Wash, Utah, they are primarily insectivorous in late winter. Important foods include stratiomyid and hydropsyche larvae, and adult ephemeropterans and trichopterans (Angradi et al. 1991).

The Virgin River spinedace usually spawns over gravel and sand substrates at the lower ends of pools on or near the bottom (Minckley 1973). It spawns April-June and reaches maturity after one year. One- and two-year-old females spawn once/season. Three-year-old females may spawn twice in a season (Lee et al. 1980).

CONSERVATION CHALLENGES:

About 40% of the historic habitat has been lost due to human impacts, including habitat fragmentation, introduction of non-native fishes, and dewatering associated with agriculture, mining, and urbanization. These impacts continue to threaten populations (USFWS, Federal Register, 18 May 1994, 30 June 1994). In NV, the Virgin River spinedace was extirpated from historic habitat in Beaver Dam Wash in the early 1960s for unknown reasons, possibly related to dewatering associated with the construction of Schroeder Reservoir or thermal effects from storage of water in the reservoir upstream of occupied spinedace habitat.

NEEDS:

Research Needs: Extent of trout predation/competition, survival of reintroduced fish, and recruitment of reintroduced fish all require research.

Monitoring and Existing Plans: Semi-annual surveys are conducted by NDOW and UDWR to evaluate the reintroduction effort in Beaver Dam Wash. Existing plans include the Virgin Spinedace CAS and the Watch List species in the Clark County MSHCP.

Approach: Rangewide conservation efforts are directed by implementation of the Virgin Spinedace Conservation Agreement and Strategy (UDWR 2002). This will reestablish and maintain required water flows and restore 50% of lost historical habitat. For NV, identified actions are re-establishment of a viable population in Beaver Dam Wash within historic habitat, using fish from the lower Beaver Dam Wash populations in UT and AZ. Reestablishment efforts have been ongoing since 1997 and appear to be successful with evidence of a persistent recruiting population in Nevada reaches of Beaver Dam Wash.

WAP HABITAT LINKS: Warm Desert Riparian.

Wall Canyon sucker *Catostomus sp. 1*

WAP 2012 species due to threats from exotic invasive species and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Fish NAC 503.065.1
CCVI	Moderately Vulnerable

TREND: Declining population due to invasive crayfish and non-native brown trout.

DISTRIBUTION: Known distribution from Wall Canyon Creek and a single tributary (Mountain View Cr.) Washoe County.

GENERAL HABITAT AND LIFE HISTORY:

Known only from Wall Canyon and Mountain View creeks.

CONSERVATION CHALLENGES:

Stream banks and riparian vegetation are subject to damage from overgrazing. Annual stream surveys in these waters indicated that the Wall Canyon Sucker was being displaced and moving further up into headwater sections. Efforts to physically eradicate non-native piscivorus trout were unsuccessful. Although trout stocking has ceased, self-sustaining populations remain and are moving further upstream.

NEEDS:

Research Needs: Monitor impact of grazing practices on habitat. Need information on suitable habitat and reproduction.

Monitoring and Existing Plans: Annual surveys are conducted by NDOW. A Wall Canyon Sucker Working Group was created to address issues impacting the sucker, and a Wall Canyon Sucker Conservation Agreement and Strategy was written in 2002.

Approach: One of the major accomplishments in June of 2007 was building a trout barrier to prevent them from moving any farther into the suckers current habitat. In 2010, additional grant funding for assisting and construction of a barrier on Mountain View Creek to further reduce impacts from non-native species, was procured from the Desert Fish Habitat Partnership non-native fish and crayfish impacts.

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs.

Warm Springs Amargosa pupfish *Cyprinodon nevadensis pectoralis*

WAP 2012 species due to its federal endangered status, small population size, degraded habitat, and threats from exotic invasive species.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Small stable to increasing population.

DISTRIBUTION: Endemic to several small thermal spring systems within Ash Meadows National Wildlife Refuge, Nye County NV. This subspecies of Amargosa pupfish occurs only within a complex of 7 small thermal springs within an area of less than 2.6 km2 (1 square mile), near Devils Hole.

GENERAL HABITAT AND LIFE HISTORY:

Habitats are small springs with source pools <2m diameter or absent (Soltz and Naiman 1978). These low-discharge, warm (30-31° C (86-88 F)) and constant temperature thermal springs and their outflows are largely isolated from each other.

The Warm Springs Amargosa pupfish represents one of the world's smallest self-sustaining vertebrate populations ranging from 20 to 150 individuals each. It is the smallest of the C. nevadensis subspecies with a shorter, deeper body, more numerous pectoral fin rays and general absence of pelvic fins. It spawns most of year, with the peak in April-June.

CONSERVATION CHALLENGES:

Primary threats are lowering of water table and competition and predation by introduced fishes and crayfish. Threats related to water development (for agriculture and residential development) have been decreased with the establishment of the Ash Meadows NWR, but potential future threats continue from proposed groundwater development activities. Threats posed by introduced fishes and crayfish remain. This pupfish subspecies occurs in small spring outflow habitats and more aggressive active management may be required to maintain habitat quality and avoid loss from encroachment of dense vegetation and sedimentation.

NEEDS:

Research Needs: Continued monitoring of populations and habitat is necessary. Research is needed to determine effective genetic population size, develop design/habitat parameters for site restorations.

Monitoring and Existing Plans: Surveys are conducted annually by Ash Meadows NWR and NDOW. Included in the Recovery Plan for the Endangered and Threatened Species of Ash Meadows, Nevada. Ongoing restoration activities include, exotic crayfish removal and recent land acquisition to increase protected habitat. A genetic management plan was completed (Martin 2010).

Approach: Ensure the perpetuation of multiple viable populations. Continue focused restoration efforts on key habitats. Monitor and control occurrence of introduced aquatic species. Monitor habitat quantity and quality and implement maintenance activities to preserve habitat characteristics as required. Monitor spring flows. See Ash Meadows Species Recovery Plan (USFWS 1990b). Maintenance of the full complex of source pools and headwaters is essential to prevent extinction of the species (Minckley et al. 1991).

WAP HABITAT LINKS: Springs and Springbrooks.

Warner sucker *Catostomus warnerensis*

WAP 2012 species due to its limited range, habitat modifications, and ESA listing status, and moderate vulnerability to climate change.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LT
BLM-NV	Sensitive
State Prot	Protected Fish NAC 503.065.1
CCVI	Moderately Vulnerable

TREND: Trend is stable however, the distribution of this taxon was found to be patchy with distinct areas of relatively high abundance.

DISTRIBUTION: Although it occurs more extensively within the Warner Basin, Oregon, currently within Nevada it is found in patchy distributions in Twelvemile Creek and, most likely, a few of its tributaries most notably Rock Creek.

GENERAL HABITAT AND LIFE HISTORY:

Historically abundant and widely distributed in the basin, the Warner sucker still maintains sizable numbers in a few habitats. It is still known to occur in most lakes, sloughs, and potholes, except during drought years. Stream resident populations are found in Honey and Twentymile creeks and tributaries (including Twelvemile Cr. in NV). In most habitats the Warner sucker is rare, although aggregations of spawning adults or young-of-the-year may be encountered. The Warner sucker inhabits the lakes and low gradient stream reaches of the Warner Valley. The metapopulation of Warner suckers is comprised of two life history forms: lake and stream morphs (Scheerer 2009). Larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near macrophytes (aquatic plants). Young-of-the-year use deep still pools, but also move into faster flowing areas near the heads of pools. Adults use stretches of stream where the gradient is low enough to allow the formation of long, >50 meters (>164 feet), pools. These pools tend to have undercut banks, large beds of aquatic macrophytes, root wads or boulders, a vertical temperature differential of at least 2º C (35.6º F), a maximum depth >1.5 meters (>5 feet), and over-hanging vegetation (Richardson 2009).

CONSERVATION CHALLENGES:

General stream channel and watershed degradation from livestock grazing has caused hydrologic impacts to sucker habitat. In addition, numerous small, agricultural diversion dams on creeks reduce stream flows and prevent migrations of adults and young. The Warner sucker has a limited range, with only one stream in NV. It is listed as ESA Threatened.

NEEDS:

Research Needs: There is an ongoing study of PIT Tagging adults for movement studies.

Monitoring and Existing Plans: Existing plans include the Recovery Plan for Threatened, the Rare Native Fishes of Warner Basin 1998 and USESA Threatened Fish with Critical Habitat delineated. Yearly population and distribution surveys are done by ODFW. Construction of a fishway for passage over a diversion dam on Twentymile Creek. The Bureau of Land Management and the USDA Forest Service have altered their grazing and forest management practices to improve habitat for Warner suckers. Additional conservation measures are needed, including improvement of stream habitat and watershed conditions throughout the Warner Basin, re-establishing migration corridors, screening irrigation diversions, controlling exotic fishes, and maintaining adequate water supplies for fish.

Approach: Current restoration and connectivitiy measures of Twentymile and Twelvemile Creeks should continue.

WAP HABITAT LINKS: Intermountain Riparian.

Warner Valley redband trout *Oncorhynchus mykiss pop. 4*

WAP 2012 species due to limited distribution and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G5T2QS1
USFWS	No Status
USFS-R5	Sensitive
CCVI	Highly Vulnerable

TREND: Warner Valley redband trout abundance declined by 23% since last surveyed intensively in 2007. However, 2010 estimates show over a 50% decline from the previous two level sampling years (Miller et al 2010).

DISTRIBUTION: Restricted to the Twelvemile Creek and its tributary Rock Creek in extreme northwestern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Redband trout (O. m. newberrii) inhabit streams in arid environments, ranging from montane forests to desert shrub and grasslands (Benhke 1992), where extreme fluctuation in flow and temperature are common. Great Basin redband trout populations persist in fragmented habitats and are isolated from core riverine groups. Redband trout populations in all of these pluvial lake basins have evolved adfluvial life histories, such that many populations may have further adapted to these unique environments.

CONSERVATION CHALLENGES:

Factors, other than seasonal flow, that likely affect trout productivity are flow diversions, migration barriers, riparian habitat, competition with exotic salmonids, and climate regime. Continued habitat fragmentation, degraded habitat quality and limited connectivity may hinder movement and reduce abundance. Protection of current populations requires increasing the size and extent of populations, maintaining genetic and life history diversity, increasing connectivity, minimizing anthropogenic stressors, and improving adaptive management.

NEEDS:

Research Needs: Multi-year intensive monitoring by Oregon Department of Wildlife is ongoing.

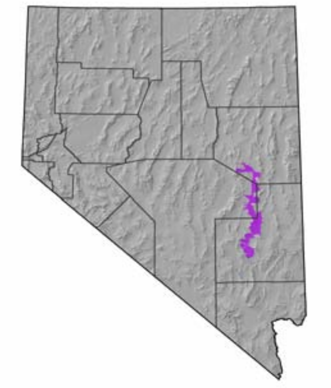
Monitoring and Existing Plans: Annual population surveys are done by ODFW and will continue through 2012 at which time the program will be reassessed by ODFW. Limited access, due to denial from private land owners (roughly 60%), has been an issue for surveying and determining entire distribution (Dambacher et al. 1999). This species was proposed for federal listing in 1998 but found "Not Warranted." Warner Valley redband trout are currently studied under Oregon's State Management Unit (SMU) program to address conservation needs, recovery efforts and management actions on native fishes in the state.

Approach: Continue yearly sampling, particularly at the stratum level and at annual established survey sites. Continue to study the yearly effects of natural variation. Redband are limited by flow diversions, migration barriers, degraded riparian habitat, competition with nonnative salmonids, and climate regime. Protection of current populations requires increasing the size and extent of populations, maintaining genetic and life history diversity, increasing connectivity, minimizing anthropogenic stressors such as water withdrawals, nonnative salmonids, and improving adaptive management.

WAP HABITAT LINKS: Intermountain Riparian.

White River desert sucker *Catostomus clarkii intermedius*

WAP 2012 species due to loss of historic populations, habitat fragmentation, threats from water development and exotic invasive species, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G3G4T1T2QS1S2
USFWS	No Status
State Prot	Protected Fish NAC 503.065.1
CCVI	Highly Vulnerable

TREND: Population declining except for Flag Spring population at Kirch WMA.

DISTRIBUTION: Limited to isolated spring, stream and spring outflow systems in White Pine and Nye Counties, NV.

GENERAL HABITAT AND LIFE HISTORY:

No specific life history information is available for this sub-species. Basic life history requirements are assumed to be similar to other desert suckers which inhabit isolated pond and spring outflow systems

CONSERVATION CHALLENGES:

Distribution and abundance of this subspecies have declined since 1981, with some isolated populations apparently lost in spring/outflow systems in the Preston/Lund area, White Pine County. Primary impacts have been from alteration, fragmentation and loss of spring and outflow habitats, loss of connectivity between these habitats, and the introduction of nonnative competitors and predators. Potential future threats exist from proposed ground and surface water development projects. The majority of locations for this subspecies are on private lands which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Life history information to assist in development of habitat restoration strategies is needed, in addition to, a better definition of taxonomic relationship to other desert suckers (Starnes 1995).

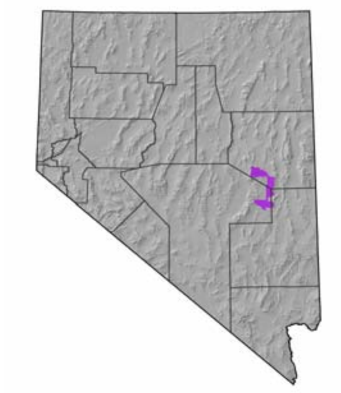
Monitoring and Existing Plans: Desert sucker are monitored periodically in conjunction with other efforts for White River native fishes, by NDOW, USFS and USFWS, but there is no monitoring program specifically for this species. White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on the restoration and enhancement of habitats, control of nonnative predators/competitors, and developing agreements with private landowners to insure access to all extant populations and long-term protection and management of occupied habitats. A more comprehensive scheduled monitoring strategy is needed to gauge success of conservation efforts. (Scoppettone and Rissler 2002). NDOW is developing a Programmatic Candidate Conservation Agreement with Assurances to assist in the development of landowner agreements for private land conservation.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks, Lakes and Reservoirs.

White River speckled dace *Rhinichthys osculus ssp. 7*

WAP 2012 species due to loss of historic populations, habitat fragmentation, threats from water development and exotic invasive species, and vulnerability to climate change.



Agency Status	
NV Natural Heritage	G5T2T3QS2S3
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: Trend is unknown except for Flag Spring population at Kirch WMA, which is stable.

DISTRIBUTION: Found in upper portions of pluvial White River including Flag Springs outflow, a select few springs in the Lund area and portions of the upper White River.

GENERAL HABITAT AND LIFE HISTORY:

No specific life history or habitat use information is available for this subspecies. Speckled dace occupy an extraordinary array of habitats, springs and outflows, streams, pools, ponds, even intermittent streams. However, clear, well oxygenated water with abundant cover of woody debris or overhanging banks along with moving water or wave action in the form of wind appear to be essential for continued persistence. Preferable habitats often include shallow riffle and sometimes channelized streams with reduced flow. Speckled dace are seldom found singly but generally avoid forming conspicuous shoals except during breeding season (Moyle 2002). Feeding habits generally include browsers of small invertebrates particularly in riffle sections. They can however feed opportunistically on flying insects as well zooplankton, diet changes with season reflecting prey availability. Speckled dace have a short life span and few fish live beyond age 3. Generally dace mature their second season seeking out shallow areas where gravel is suitable for spawning generally in late spring as water temperatures rise, a high mortality is associated with spawning adults (Wydoski and Whitney 2003). Eggs remain in the gravel for 7 to 8 days before larval fish emerge.

CONSERVATION CHALLENGES:

Small local populations are vulnerable to habitat alteration and exotic species. Reasons for decline include dewatering of springs, headwaters, and middle portions of major streams, water impoundment, channelization, diversion, regulation of discharges, and interactions with non-native species (Minckley 1985, Moyle et al. 1989). See Taylor et al. (1989) for information on negative impact of cattle on desert spring populations (chemical alteration of water).

NEEDS:

Research Needs: Annual monitoring and surveys at established locations, in addition to, a comprehenisve inventory of all potential waters that have suitable habitat, are needed.

Monitoring and Existing Plans: The Upper White River RIT team was formed in 2000. Protections exist within the critical habitat as it co-occurs with White River spinedace. Annual NDOW surveys occur on some known populations.

Approach: Continue habitat enhancements and conservation measures including reintroduction efforts.

WAP HABITAT LINKS: Intermountain Riparian.

White River spinedace *Lepidomeda albivallis*

WAP 2012 species due to its federal endangered status, loss of historic populations, limited population size, limited distribution, and threats of groundwater development.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Upper White River drainage, Nye and White Pine Counties NV. Presently occurs only within a single spring and outflow system at Kirch Wildlife Management Area, Nye Co.

GENERAL HABITAT AND LIFE HISTORY:

The White River spinedace occurs in cool, clear springs and their outflow systems, over sand and gravel substrate. It seems to prefer shallow areas (0.5-1.5 m (1.6-4.9 ft) deep) (Lee et al. 1980). The most common aquatic plants in its habitat are watercress, pondweed, rush, and cattail. Surrounding vegetation is needed for shade and as habitat for insects upon which the spinedace feeds (Matthews and Moseley 1990).

This species is omnivorous but feeds primarily on aquatic invertebrates. It also ingests plant material, algae, and detritus (Scoppettone et al. 2004).

The White River spinedace is believed to have evolved in clear, cool waters within Pluvial White River System, NV (Lee et al. 1980). It is highly localized in a small area. Its range in mid-1900s included Preston Big Spring; Nicholas, Arnoldson, Cold, Lund, and Flag springs; and the White River near its confluence with Ellison Creek.

CONSERVATION CHALLENGES:

This species occurred in at least seven locations in the 1930s but is now reduced to a single secure population in the wild (Scoppettone et al 2004). Principal threats resulting in loss of populations include habitat alteration (channelization, diversion of springs) and introductions of nonnative competitors and predators including mosquitofish, guppies, and largemouth bass. Development and alteration of spring outflows has fragmented remaining habitats. Because of bright coloration and behavior this species is especially vulnerable to aquatic and avian predators. Potential future threats exist from proposed ground and surface water development projects. The majority of historic habitats for this species are on private lands which are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Habitat utilization and relationship studies are needed to assist in developing restoration strategies for historic habitats.

Monitoring and Existing Plans: Semiannual status and population monitoring is conducted by NDOW and USFWS. White River Native Fishes Management Plan.

Approach: Conservation actions are reviewed and implemented through the White River Native Fishes RIT which meets semi-annually. The White River Native Fishes Management Plan (NDOW 2001) provides management guidance. Current efforts are focused on maintenance of existing occupied habitat and the restoration and enhancement of historic habitats to support re-establishment efforts, control of nonnative predators and competitors, and developing agreements with private landowners to provide locations to re-establish populations and provide long-term protection and management of those historic habitats. Efforts are ongoing to establish a second population on public lands in upper White River Valley.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks.

White River springfish *Crenichthys baileyi baileyi*

WAP 2012 species due to its federal endangered status, habitat degradation, and threats from exotic invasive species and recreational activities.

Agency Status	
NV Natural Heritage	G2T1S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend is stable.

DISTRIBUTION: Endemic to pluvial White River drainage in Pahranagat Valley, this subspecies <i>baileyi</i> occurs only in Ash Spring and outflow, Lincoln County NV.

GENERAL HABITAT AND LIFE HISTORY:

According to Tuttle et al (1990) few springfish were observed in the Ash Springs outflow; no more than three were sighted in any one season in three years of study. Virtually the entire White River springfish population occurred in Ash Springs pool. Population estimates varied considerably over the three year study and ranged from 1,050 in the fall of 1986 to 2,685 in the winter of 1988. Only adults (> 25 mm TL) were counted. There was no apparent seasonal pattern for abundance. Adult White River springfish were found in a wide range of total water depths, reflective of the wide range of depths available in Ash Springs pool. Focal depth (depth from bottom) and relative depth (percent of total water depth) suggest the majority were closer to the bottom. Juveniles (10 to 25 mm TL) and larvae (< 10 mm TL) generally occurred in shallower water, and were more vertically dispersed than adults. Virtually all springfish occurred in pool habitat at zero velocity. Other life history characteristics for White River springfish are similar to other C. baileyi subspecies.

CONSERVATION CHALLENGES:

This subspecies of White River springfish occurs at only a single spring and spring outflow location with the majority of occupied habitat on private lands. Stresses and threats exist from alteration to occupied habitats, recreational uses, and the presence of nonnative competitors and predators including convict cichlids (Cichlasoma nigrofasciatum), shortfin mollies (Poecilia mexicana), and mosquitofish (Gambusia affinis) (Courtenay et al. 1985; Tippie et al. 1991). Potential future threats exist from proposed ground and surface water development projects. The private lands containing the majority of habitat are not included under any type of agreements or easements which would assure long-term security and protection.

NEEDS:

Research Needs: Habitat preference and interspecific competition research is needed.

Monitoring and Existing Plans: Annual dive count surveys are conducted by NDOW, but access has been periodically limited on private lands. A more comprehensive survey protocol is needed to be inclusive of entire occupied habitat. Existing plans include the Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley and the Pahranagat Valley Native Fishes Management Plan.

Approach: Pahranagat Valley Native Fishes Recovery Implementation Team (RIT) meets semi-annually to review conservation status and actions and coordinate activities. RIT team implements Pahranagat Valley Native Fish Management Plan (NDOW 2000b) which identifies key goals/objectives/actions. Key conservation elements include habitat restoration and protection, and control/removal of introduced nonnative fishes in occupied habitats. Efforts to physically remove nonnative fishes from Ash Spring and its outflow are ongoing. NDOW is pursuing development of landowner agreements to provide long term security for habitat through development of a Pahranagat Valley Programmatic Safe Harbor Agreement. Priority actions include development of agreements with landowners to insure access to the single wild population and allow restoration of occupied habitats.

WAP HABITAT LINKS: Intermountain Riparian, Springs and Springbrooks.

woundfin *Plagopterus argentissimus*

WAP 2012 species due to its federal endangered status and near extirpation.

Agency Status	
NV Natural Heritage	G1S1
USFWS	LE, XN
BLM-NV	Sensitive
State Prot	Endangered Fish NAC 503.065.2
CCVI	Presumed Stable

TREND: Trend unknown. May be extirpated from NV reaches of the Virgin River.

DISTRIBUTION: Occurs only in the Virgin River UT, AZ, and NV, from Pah Tempe (La Verkin) Springs, Washington County, UT, downstream through Mohave County, AZ, to Lake Mead, Clark County, NV. Occurrence of woundfin is currently rare in river reaches downstream of Littlefield, AZ.

GENERAL HABITAT AND LIFE HISTORY:

The woundfin occupies main channels of seasonally swift, highly turbid, extremely warm, small to medium rivers, with sandy, constantly shifting bottoms (Lee et al. 1980, Page and Burr 1991). It prefers runs and quiet waters adjacent to shallow riffles (Matthews and Moseley 1990). Larvae utilize shallow areas lateral to the main current. Young usually are in quiet sections or isolated pools in clear water where algae is present (USFWS 1995b). The woundfin spawns in swifter flowing water over beds of cobble or gravel. Females return to pools after spawning (Matthews and Moseley 1990).

The woundfin apparently feeds on aquatic insects, detritus and algae. Near Mesquite, Nevada, it feeds primarily on ceratopogonid larvae in February, mayflies in June, chironomids and ceratopogonids in December. Near Beaver Dam Wash, it feeds primarily on chironomid larvae and organic debris in February, Tamarix seeds, simuliid larvae, organic debris, and mayflies in June, chironomid larvae, organic debris, and spirogyra in September, and ceratopongonids, simuliid pupae, chironomid larvae, and organic debris in December (Greger and Deacon 1988).

The life span of the woundfin is apparently seldom, if ever, more than 4 years. Its reproductive cycle probably is triggered by increasing temperature and declining spring runoff in late May (Matthews and Moseley 1990). In captivity, most spawn the second spring after hatching and most survive two reproductive seasons (Minckley and Deacon 1991).

CONSERVATION CHALLENGES:

Woundfin distribution and abundance has declined severely in Nevada reaches of the Virgin River and catch rates declined significantly beginning in the 2000s. Woundfin are now extremely rare in any NV reach and apparently absent below Mesquite NV. Recent drought conditions, water diversions, and invasive salt cedar have altered aquatic habitats, but a major element in the decline of this fish in the Virgin River has been introduced red shiner (Cyprinella lutrensis) and tilapia (Tilapia aurea). More recently, gizzard shad have been detected upstream to the Mesquite area. Existing fish barriers to prevent upstream movement of nonnative species from Lake Mead are inadequate or absent. River modifications including diversions and channelization have fragmented habitats and directly altered aquatic habitat quality. Additional potential stressors include further habitat alteration, disease, competition with or predation by introduced species, and groundwater and surface water development actions.

NEEDS:

Research Needs: Artificial propagation methods, introduction techniques, habitat requirements and preferences, and interspecific interaction with other native and nonnative fishes are all areas for research. Efforts are ongoing at the Dexter National Fish Hatchery and Technology Center to research temperature tolerance levels of the species. This facility also provides the sole source of woundfin for the restocking efforts that occur in the Utah reaches of the Virgin River.

WAP HABITAT LINKS: Warm Desert Riparian.

Monitoring and Existing Plans: Semiannual monitoring surveys occur through the Virgin River Fishes Recovery Team. Additional periodic monitoring is conducted by NDOW and SNWA contractors. This species is addressed in the Virgin River Fishes Recovery Plan, the Draft Lower Virgin River Recovery Implementation Strategy, and the Virgin River HCRP draft program plan.

Approach: Virgin River conservation activities are implemented by the Recovery Team and Lower Virgin River RIT, under the guidance of the Virgin River Fishes Recovery Plan (USFWS 1995b). Current efforts are focused on control and containment of nonnative fishes, primarily red shiner and tilapia, restoration of habitat including control of salt cedar and other invasive plants which alter and stabilize river habitats, creating effective fish barriers to preclude upstream establishment of new nonnative species, maintaining flows and water quality, and stocking of cultured sub-adult fish to re-establish population numbers. Re-introduction efforts in NV to date have been limited to areas above the Bunkerville Diversion near Mesquite NV. The Virgin River HCRP is currently under development and may provide additional resources for conservation efforts for this species.

WAP HABITAT LINKS: Warm Desert Riparian.

Yellowstone cutthroat trout *Oncorhynchus clarkii bouvieri*

WAP 2012 species due to competition with brook trout, habitat issues, and vulnerability to climate change.

Agency Status	
NV Natural Heritage	G4T2S1
USFWS	No Status
USFS-R4	Sensitive
State Prot	Game Fish NAC 503.060
CCVI	Moderately Vulnerable

TREND: Although Yellowstone cutthroat populations are broadly distributed and many remain robust in headwater streams, migratory populations in large rivers and lakes have declined substantially (Meyer et al. 2006b, May et al. 2007).

DISTRIBUTION: Found only in extreme northeast NV, in Goose Creek and its tributaries, including Little Goose, Trout, Piney, and Coon creeks.

GENERAL HABITAT AND LIFE HISTORY:

Headwater populations frequently occur above migration barriers that protect them from competition, predation, and introgression from non-indigenous trout, and many of these populations are believed to be large enough to be resilient to stochastic disturbance (Kruse et al. 2001, Meyer et al. 2006b, May et al. 2007). In a recent study, Cegelski et al. (2006) determined that Yellowstone cutthroat trout were genetically structured at the major river drainage level, but evidence suggested that habitat fragmentation had altered that structure. For example, the system with the least altered migration corridors (11 major river drainages examined in the study) exhibited the highest levels of genetic diversity and low levels of genetic differentiation. High levels of genetic differentiation were observed at similar or smaller geographic scales in stream networks that have been more altered by anthropogenic activities (Cegelski et al. 2006).

CONSERVATION CHALLENGES:

Threats include introduced fishes, hybridization with rainbow trout, habitat degradation, water diversions, grazing, mineral extraction, road construction, migration barriers, streambank instability, habitat fragmentation, wildfire, and climate change. Unfortunately, isolation and fragmentation, especially in small headwater drainages, substantially increase the risk of demographic collapse (Kruse et al. 2001) following catastrophic disturbances (e.g., wildfire and subsequent flooding and debris flow events).

NEEDS:

Research Needs: Recent unpublished information suggests that Yellowstone cutthroat trout are currently present at 47 percent of 961 sites in the historical range of Idaho, Utah, and Nevada (84 percent of the sample sites were randomly selected). Recent efforts to evaluate Yellowstone cutthroat trout abundance have evolved from a qualitative assessment of density to population estimates of mature individuals in each habitat segment. Standard mark-recapture and depletion techniques are more frequently used to provide estimates of abundance and precision (Budy et al. 2007). More specifically, information concerning life-history diversity and its relationship to genetic variation are critical to the protection of the remaining populations of Yellowstone cutthroat trout.

Monitoring and Existing Plans: In 2000 an MOU among fish management agencies of all five states that YCT historically occur in was initiated to insure its persistence. A major effort of this MOU is to identify genetically unaltered populations of YCT.

WAP HABITAT LINKS: Intermountain Riparian.

Approach: It appears that the proportion of the range that supports healthy, secure core conservation populations (genetically unaltered and suspected genetically unaltered) is low. Core populations are currently found on 10 percent of its historical range, or 35 percent of the currently occupied range. Only four populations (24 km of stream habitat) exist where non-indigenous salmonids do not occur. Given the array of potential factors that are negatively affecting Yellowstone cutthroat trout populations, persistence of core populations is not certain. Conservation of the subspecies may benefit from a hierarchical approach that includes (1) protection of the strongest core conservation populations; (2) enhancement by reconnecting and replicating the core populations whenever possible; and (3) restoration of populations when practical.

WAP HABITAT LINKS: Intermountain Riparian.

Amargosa toad *Anaxyrus nelsoni*

WAP 2012 species because it is an endemic species with a very small range and relatively small population numbers.

Agency Status	
NV Natural Heritage	G2S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Amphibians NAC 503.075.2
IUCN	Endangered
CCVI	Presumed Stable

TREND: Overall stable; combined adult population estimates for sites monitored annually by NDOW have fluctuated between 1,100 and 3,000 individuals between 1998 and 2011 (USFWS 2010a).

DISTRIBUTION: Amargosa toads are endemic to the Amargosa River drainage in southwestern Nevada. Estimated known and potential Amargosa toad habitat as delineated by the Amargosa Toad Working Group in 2007 was approximately 8,440 acres (USFWS 2010a).

GENERAL HABITAT AND LIFE HISTORY:

Habitat requirements for breeding and population recruitment include the presence of open, ponded, or flowing water, with riparian vegetative cover in an early-to-intermediate successional stage to form a partial canopy for shade with minimal emergent vegetation at the water's edges. Immature (metamorphs or toadlets) and adult Amargosa toads are dependent upon the areas described above, as well as areas they can use for shelter, including burrows, debris piles, spaces under logs or rocks, and areas of dense vegetation. Adult toads also require adjacent vegetated uplands for nocturnal foraging (USFWS 2010a).

The breeding season begins in mid-February and may extend into July, during which time adults congregate at breeding sites. Amargosa toad tadpoles require relatively open water that persists long enough for the completion of metamorphosis and development into toadlets, which occur over approximately 30 days. Predation and early desiccation of wetlands needed for breeding may affect success at entire breeding sites. Although Amargosa toads typically live 4 to 5 years, individual toads are known to live up to 17 years based on data from NDOW's population monitoring program (USFWS 2010a).

CONSERVATION CHALLENGES:

Some occupied and potential habitats have been degraded by feral animal impacts, physical alteration, and development. Access for monitoring and management is restricted for some habitats on private lands. Some habitats are adversely affected by overgrowth of emergent vegetation. Some degree of disturbance may be important for toad persistence, particularly at small, isolated spring sites. Occurrence and effects of amphibian diseases (esp. Bd) are largely unknown.

NEEDS:

Research Needs: Research needs include developing methods for control of nonnative species (esp. crayfish and bullfrogs); obtaining life history information including migration and movements; researching habitat relationships including methods for maintaining habitat quality, and research on genetic relationship to other toads in lower Amargosa River drainage system. Some assessment of diseases has been conducted but additional surveys to assess occurrence and susceptibility to Bd would be useful.

Monitoring and Existing Plans: Semi-annual monitoring directed by NDOW, with assistance from partners including BLM, USFWS, NNHP, TNC, community volunteers, and others. Conservation actions are directed by the cooperative Amargosa Toad Conservation Agreement and Strategy (NDOW 2000) and the multi-agency Amargosa Toad Working Group. Amphibian disease (Bd) assessment is ongoing by UNLV in conjunction with monitoring surveys.

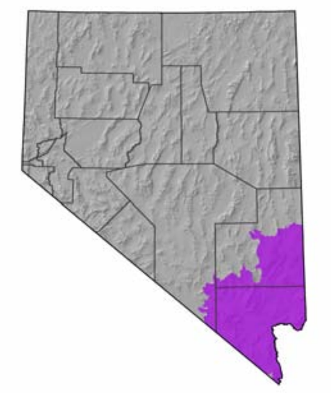
WAP HABITAT LINKS: Marshes, Warm Desert Riparian, Wet Meadow, Springs and Springbrooks, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

Approach: Majority of habitat is on private property, thus private-public-NGO partnerships are critical. The Town of Beatty is developing a community based conservation program which will protect toad habitat on surrounding public lands while accommodating public recreation in lieu of BLM Area of Critical Environmental Concern (ACEC) designation. TNC has purchased two ranches near Beatty for experimental habitat management (Burroughs 1999). Nye County is a cooperator with state and federal agencies in the conservation agreement (Burroughs 1999). Other private and public partners are assisting with management actions on public and private land (e.g. STORM-OV). Active management of occupied habitats to maintain intermediate seral stages and shallow water areas for breeding, and control of nonnative species, are key conservation actions.

WAP HABITAT LINKS: Marshes, Warm Desert Riparian, Wet Meadow, Springs and Springbrooks, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

Arizona toad *Anaxyrus microscaphus*

WAP 2012 species because of declining trend and hybridization of this highly fragmented species.



Agency Status	
NV Natural Heritage	G3G4S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Declining, but the rate of decline is unknown. Stebbins (2003) estimates that this species has disappeared from 75% of its historic range.

DISTRIBUTION: Restricted to Meadow Valley Wash and Virgin River drainages in NV. It was historically in Las Vegas Valley but it is now believed extirpated from this area. Globally, this species has a highly fragmented range.

GENERAL HABITAT AND LIFE HISTORY:

Information in NV is largely lacking, but in other areas, they are found in riparian areas from lowlands to high uplands including pine-oak scrubland. They have been found in rocky stream courses in pine-oak zone in Arizona and New Mexico. In Utah, they occur along irrigation ditches and in flooded fields, as well as along streams bordered by willows and cottonwoods (Stebbins 1954). Irrigated cropland and reservoirs are increasingly being used in some areas (Price and Sullivan 1988).The Arizona toad lays eggs among gravel, leaves, or sticks, or on mud or clean sand, at bottom of flowing or shallow quiet waters of perennial or semipermanent streams (Dahl et al. 2000) or shallow ponds.

Diet includes snails, crickets, beetles, and ants; sometimes cannibalizes newly metamorphosed individuals. Larvae probably eat algae, organic debris, and plant tissue.

Breeding is not dependent upon rainfall, but on warming temperatures and water levels. Spring flooding delays breeding. Breeding may occur for 10-12 days at a location, then stop due to rain and floods, and continue again following warmer, drier weather. Eggs hatch in 3-6 days and tadpoles metamorphose in 3-4 months depending on varying environmental conditions.

CONSERVATION CHALLENGES:

Threatened by loss and degradation of habitat from exotic predators, OHV use, construction of water impoundments, and groundwater pumping activities that lead to declines in seeps and springs. It readily hybridizes with Woodhouse's toad (Anaxyrus woodhousii), which is expanding its range into traditionally A. microscaphus habitats. Water impoundments seem to favor A. woodhousii over A. microscaphus.

NEEDS:

Research Needs: Basic life history information and better distribution information is needed for this species in NV. Extent of interbreeding with B. woodhouseii and current distribution of un-hybridized populations should be studied.

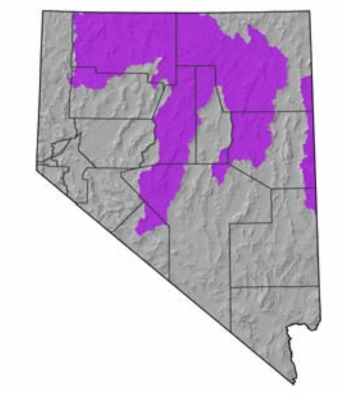
Monitoring and Existing Plans: Limited distribution assessment through Clark County MSHCP, no ongoing monitoring program. Evaluation Species in the Clark County MSHCP and Covered in the Partners in Amphibian and Reptile Conservation Amphibian and Reptile Habitat Management Guidelines.

Approach: Conduct investigations into life history, including basic population demography, status and trends. Develop conservation plan as demonstrated by need.

WAP HABITAT LINKS: Warm Desert Riparian, Lakes and Reservoirs, Springs and Springbrooks.

Columbia spotted frog (Great Basin pop) *Rana luteiventris pop. 3*

WAP 2012 species because this species has a highly fragmented and limited range in Nevada and has demonstrated declines from historic numbers. It is also a Candidate species for listing under the Endangered Species Act.



Agency Status	
NV Natural Heritage	G4T2T3QS2S3
USFWS	C
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Protected Amphibians NAC 503.075.2
CCVI	Highly Vulnerable

TREND: Populations generally stable but local declines have been demonstrated.

DISTRIBUTION: Columbia spotted frogs occur in three geographically separated subpopulations in the Jarbidge and Independence Mountains, the Ruby Mountains, and in the Toiyabe Mountains.

GENERAL HABITAT AND LIFE HISTORY:

Columbia spotted frogs are closely associated with clear, slow-moving or ponded surface waters, with little shade, and relatively constant water temperatures. Breeding and egg-laying occurs in waters with floating vegetation and larger ponds such as oxbows, lakes, stock ponds, and beaver-created ponds. Females usually lay egg masses in the warmest areas of the pond, typically in shallow water. In some areas, spotted frogs are critically tied to beaver-created ponds; without these ponds, spotted frogs are typically not found. For overwintering, spotted frogs use areas that do not freeze, such as spring heads and deep undercuts with overhanging vegetation. However, they have also been observed overwintering underneath ice-covered deep ponds.

Adults feed on invertebrates, generally within one-half meter of shore on dry days. During and after rain, they may move away from permanent water to feed in wet vegetation or ephemeral puddles. Adults also feed upon mollusks, crustaceans, and arachnids. They are thought to be opportunistic feeders and feed underwater to some extent. Green algae, most often Spirogyra, provides a food source and refuge for developing tadpoles. Tadpoles consume decomposed plant material, and live green algae.

Abundance may be tied to beaver ponds in some locations; when beavers decrease, frogs may decrease as well (Spotted Frog Mtg, Reno 2002, USFWS 1997a). See the Candidate Notice of Review (USFWS 2011c) for more comprehensive information.

CONSERVATION CHALLENGES:

Potential anthropogenic impacts to spotted frog populations and their habitats include capping of springs, extraction of water for stock and mineral exploration, livestock grazing (fecal contamination, reduced wetland plant cover, direct mortality to frogs), alteration and degradation of wetland and pond features, non-native vertebrate introductions, and herbicide applications to wetlands. Occurrence and effects of amphibian diseases (esp. Bd) are largely unknown.

NEEDS:

Research Needs: Life history information especially hibernacula requirements for overwinter survival, methods for effective habitat maintenance and restoration, and effects of livestock grazing should be a focus of research.

Monitoring and Existing Plans: Two Conservation Agreements and Strategies (CAS) have been implemented for all subpopulations of this species. One covers the Toiyabe subpopulation and the other one covers the Jarbidge, Independence, and Ruby Mountain populations (collectively referred to as the NE subpopulation). A long-term monitoring plan was completed and implemented in 2004 for the Toiyabe sub-population and a monitoring plan was recently drafted for the NE subpopulation in 2011. The Toiyabe subpopulation is surveyed annually and has a long-term mark/recapture study implemented. Sites within the NE subpopulation are monitored annually, but not comprehensively due to the extensive geographic area and ruggedness of these subpopulations. Additional surveys to assess occurrence and susceptibility to Bd is needed.

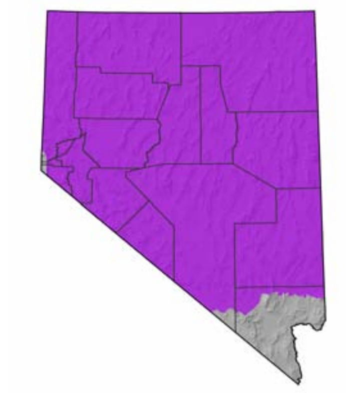
WAP HABITAT LINKS: Intermountain Riparian, Wet Meadow, Springs and Springbrooks, Marshes, Lakes and Reservoirs.

Approach: Continue to implement adaptive conservation actions delineated in the Conservation Strategies of the subpopulations. These actions focus on removal or preclusion of direct threats from nonnative species, disease and habitat loss, and identify corrective restoration strategies for protection and enhancement of key habitat areas. Technical teams for each sub-population CAS meet semi-annually to coordinate monitoring and develop management implementation actions.

WAP HABITAT LINKS: Intermountain Riparian, Wet Meadow, Springs and Springbrooks, Marshes, Lakes and Reservoirs.

Great Basin spadefoot *Spea intermontana*

WAP 2012 species because of disease concerns and potential effects of climate change on amphibians in general due to their particular life history requirements.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is stable.

DISTRIBUTION: Occurs across most of Nevada. Records exist for the Great Basin and upper elevation Mojave and Colorado Plateau ecosystems, except for southern Nye County.

GENERAL HABITAT AND LIFE HISTORY:

Mainly sagebrush flats, semi-desert shrublands, pinyon-juniper woodland. Digs its own burrow in loose soil or uses those of small mammals. Breeds in temporary or permanent water, including rain pools, pools in intermittent streams, and flooded areas along streams. Eggs are attached to vegetation in water or placed on bottom of pool.

Not well documented. Adults known to eat insects. Larvae probably eat algae, organic debris, plant tissue, etc., sometimes invertebrates and amphibian larvae.

Males reach sexual maturity at 1-2 years; females at 2 years. This species breeds between April and July depending on the location in overflow pools of permanent streams and in springs. Rainfall can stimulate breeding, but isn't always necessary. Irrigation is known to stimulate breeding as well. Breeding pools must hold water for at least 40 days for larvae to successfully metamorphose.

CONSERVATION CHALLENGES:

Could be threatened by large-scale habitat conversion. Climate change effects from temporal and spatial changes in precipitation patterns may have an unknown impact on reproductive success in some locations.

NEEDS:

Research Needs: Determine the effects of anthropogenic disturbances (e.g., agriculture, mining, development, recreation, etc). on Great Basin spadefoot terrestrial and aquatic habitats and how those disturbances affect populations. Identify potential climate change effects on habitat availability and suitability.

Monitoring and Existing Plans: This species is not currently monitored and does not occur within any other existing plans.

Approach: Additional occurrence, monitoring, and distribution information is needed to identify appropriate conservation approaches.

WAP HABITAT LINKS: Sagebrush, Intermountain Cold Desert Scrub, Intermountain Riparian, Lower Montane Woodlands and Chaparral.

Great Plains toad *Anaxyrus cognatus*

WAP 2012 species because it has a very limited range within Nevada and has been extirpated from historic sites in both Lincoln and Clark Counties.

Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown but seems to be declining based on likely extirpations from Clark and Lincoln counties.

DISTRIBUTION: Historically occurred in Clark and Lincoln Counties, but currently only found in Lincoln Co. This species reaches its western edge of range in Nevada.

GENERAL HABITAT AND LIFE HISTORY:

The Great Plains toad is found in deserts, grasslands, semidesert shrublands, open floodplains, and agricultural areas; typically in stream valleys. They are proficient burrowers and are usually underground when inactive. They breed in rain pools, flooded areas, and ponds and reservoirs that fluctuate in size. Eggs and larvae develop in shallow water (usually clear).

Metamorphosed toads eat primarily small terrestrial arthropods. Larvae eat suspended matter, organic debris, algae, and plant tissue.

Great Plains toads are inactive during cold winter months and during summer dry spells. They are mostly nocturnal but may be active diurnally during wet or humid weather. They are capable of migrating up to several hundred meters between breeding pools and non-breeding terrestrial habitats. Adults are sexually mature at 2-5 years. Individuals emerge from burrows after heavy spring rains and move to breeding wetlands generally from March to September. Breeding and egg-laying occurs in temporary pools, slow streams, irrigation ditches, holding ponds, and flooded fields. Eggs hatch in 2-7 days and tadpoles metamorphose in 17-45 days after hatching depending on the water temperature and evaporation rates.

CONSERVATION CHALLENGES:

Moderately to severely threatened by dams and water diversions, competition with non-native species, and may hybridize with B. woodhousii. Intensive cultivation and herbicide/pesticide use may be reducing populations in some regions. Experienced loss of breeding and non-breeding habitats due to suburban sprawl.

NEEDS:

Research Needs: Information on distribution, location of breeding sites, demographics, status and trend and life history for Nevada populations is needed.

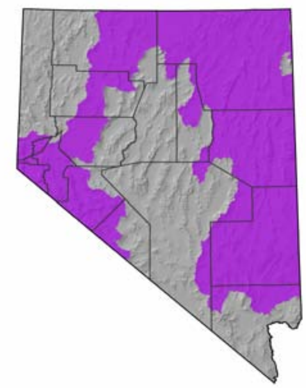
Monitoring and Existing Plans: Not currently monitored. Covered in the Partners in Amphibian and Reptile Conservation Amphibian and Reptile Habitat Management Guidelines.

Approach: Identify population loci and determine population status and trend for the species. Implement conservation actions as necessary to maintain or increase current population numbers.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Grasslands and Meadows, Agricultural Lands, Lakes and Reservoirs.

northern leopard frog *Lithobates pipiens*

WAP 2012 species due to its declining trend, known extirpations, potential climate change effects, and fragmented populations.



Agency Status	
NV Natural Heritage	G5S2S3
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Amphibians NAC 503.075.2
CCVI	Presumed Stable

TREND: Declining; limited assessment of historic locations found many to be apparently extirpated. However, further surveys over multiple years needs to be conducted to determine trend.

DISTRIBUTION: Historically occurred throughout eastern and areas of northwestern NV.

GENERAL HABITAT AND LIFE HISTORY:

Northern leopard frogs require a mosaic of habitats, including aquatic overwintering and breeding habitats, as well as upland post-breeding habitats and the links between the two. Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes are used; usually permanent water with rooted aquatic vegetation. In summer, commonly inhabits wet meadows and fields. Takes cover underwater, in damp niches, or in caves when inactive. Overwinters usually underwater and requires well-oxygenated water that does not completely freeze. Eggs are laid and larvae typically develop in shallow, still, permanent water, generally in areas well exposed to sunlight. Generally eggs are attached to vegetation just below the surface of the water.

Metamorphosed frogs eat various small invertebrates obtained along water's edge or in nearby meadows or fields; rarely eats small vertebrates. Larvae eat algae, plant tissue, organic debris, and probably some small invertebrates.

The time of egg deposition varies with latitude and elevation. Breeding often peaks when water temperatures reach about 10°C. At a particular site, egg deposition generally occurs within a span of about 10 days. Aquatic larvae metamorphose into small frogs in early to late summer, a few months after egg deposition.

CONSERVATION CHALLENGES:

Habitat degradation, fragmentation and loss due to unsustainable grazing, water impoundments or other alterations, and development (urban, agriculture) are the main threats to this species. Interactions with introduced species may also be contributing to declines. Inadequate information exists to adequately characterize current distribution and status/trend of individual isolated sub-populations. Some populations likely occur on private lands with limited access. Occurrence and effects of amphibian diseases (esp. Bd) are largely unknown. Potential climate change effects on ephemeral and permanent habitats are not well understood.

NEEDS:

Research Needs: Information is needed on the distribution of this species as well as its long-term trend. Comprehensive assessment of historic and potential sites is needed to better document statewide distribution and extensive, multi-year surveys of known populations are needed to gain a better understanding of status and trend. Additional surveys to assess occurrence and susceptibility to Bd is needed.

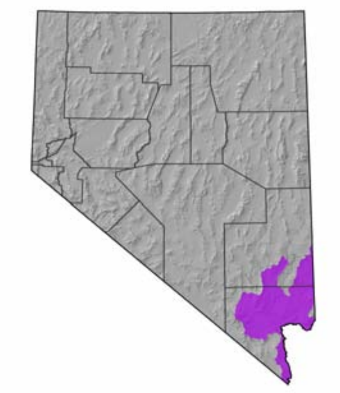
Monitoring and Existing Plans: Periodic monitoring is conducted by Humboldt-Toiyabe National Forest and NDOW for some populations. Spring Valley populations are monitored by SNWA and Pahranagat Valley populations are monitored by the USFWS. No other regular population monitoring or assessment is conducted.

Approach: Continue monitoring through USFS/NDOW partnership, SNWA, and USFWS refuges. Additional monitoring should include occupied and potential habitats on BLM and private lands. A statewide cooperative management strategy should be developed and consideration be given to development of a CCAA or similar mechanism for conservation of populations on private lands.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Wet Meadow, Intermountain Riparian, Springs and Springbrooks.

relict leopard frog *Lithobates onca*

WAP 2012 species due to its very restricted population, well-documented declines, and on-going need for extensive management actions to insure conservation of the species.



Agency Status	
NV Natural Heritage	G1G2S1
USFWS	C
BLM-NV	Sensitive
State Prot	Protected Amphibians NAC 503.075.2
CCVI	Moderately Vulnerable

TREND: Trend appears to be declining to stable in NV; variable depending on the site.

DISTRIBUTION: Restricted to only a few isolated localities including Overton Arm of Lake Mead, Black Canyon below Lake Mead, and Gold Butte area the Clark County although historically present along the Virgin, Muddy, and Colorado Rivers.

GENERAL HABITAT AND LIFE HISTORY:

Relict leopard frogs occupy spring, spring outflow, and associated marsh and wetland habitats generally in close proximity to river systems. They are active year-round, and are most often observed in shallow water along channel or pool margins. Breeding has been documented in September, November, and late January through March.

Adults probably are mainly invertivorous. Larvae probably eat algae, organic debris, plant tissue, and minute organisms in water.

Individuals reach sexual maturity in 1-2 years.

CONSERVATION CHALLENGES:

Current distribution of this species is severely reduced to eight natural and eight experimental isolated populations in Lake Mead NRA and nearby areas of Clark County and Mohave County, Arizona. Key concerns include habitat degradation from water development and diversion; modifications to spring source pools and outflows; inundation of historic habitats; changes in plant communities, including invasive plant encroachment and grazing by feral and domestic livestock; competition and predation by nonnative species; small population size; limited habitats; and fragmentation and isolation of existing habitats. Habitats in Black Canyon are subject to severe stochastic storm events which have caused the extirpation or near-loss of some natural and experimental populations. Effects of Bd and other amphibian diseases are unknown, particularly at cooler-water sites.

NEEDS:

Research Needs: Continue efforts to define current and historic distribution. Determine important breeding areas for known populations. Determine habitat requirements and conditions required for long-term survival; develop methods for maintaining favorable habitat quality. Determine population and life history characteristics. Identify and evaluate additional potential translocation or repatriation sites. Better assess occurrence and effect of Bd and other diseases. Develop additional strategies for nonnative species control and exclusion.

Monitoring and Existing Plans: Semi-annual monitoring of all known populations is ongoing under direction of the Relict Leopard Frog Conservation Team (RLFCT). The National Park Service (NPS) is the lead for monitoring efforts on NPS lands with assistance from NDOW, AGFD, UNLV, and other cooperative partners. The range-wide Relict Leopard Frog Conservation Agreement was completed in 2005 and the species is a covered species in both the Lower Colorado River MSCP and the Clark County MSHCP. Limited monitoring for occurrence of Bd is being conducted by UNLV.

Approach: Implement conservation strategy actions identified in Relict Leopard Frog CAS through direction of the RLFCT. Key actions include management of active threats, restoration and maintenance of existing and historic habitats, identification and development of additional experimental populations through translocation, and maintenance of head-start and captive breeding efforts to provide animals for population augmentation and translocation.

WAP HABITAT LINKS: Warm Desert Riparian, Springs and Springbrooks, Marshes, Desert Playas and Ephemeral Pools.

Sierra Nevada yellow-legged frog *Rana sierrae*

Although this species is considered extirpated from Nevada, this has not been confirmed and surveys and management actions should be considered for long-term reintroduction or natural repopulation as the species is extant in adjacent areas in California.

Agency Status	
NV Natural Heritage	G1G2SH
USFWS	No Status
BLM-NV	Sensitive
LTBMU	Sensitive
IUCN	Endangered
CCVI	Presumed Stable

TREND: Declining rapidly if still extant in Nevada, although it is currently considered to be extirpated from the State.

DISTRIBUTION: Restricted to the Sierra Nevada, California, and extreme western Nevada (Mt. Rose).

GENERAL HABITAT AND LIFE HISTORY:

Rarely found more than 1m from water, usually near rocky stream beds, lakes, ponds, and tarns, typically with grassy or muddy banks and edges. Both adults and larvae overwinter for up to 9 months in the bottoms of lakes that are at least 1.7m deep (some evidence that lakes at least 2.5m are ideal), under ledges of stream or lake banks, or in rocky streams.

Adults eat aquatic and terrestrial invertebrates and anuran larvae; availability of larval anuran prey may be an important factor in distribution, body condition, and survival of adults (Pope and Matthews 2002). Larvae eat algae, organic debris, plant tissue, and minute organisms in water.

Mating and egg-laying occur from May to August. Egg-laying sites must be connected to permanent lakes or ponds that do not freeze to the bottom in winter, because the tadpoles overwinter, possibly taking as many as three or four summers before they transform.

CONSERVATION CHALLENGES:

Global population declines have occurred, some in seemingly pristine environments. In the high Sierra Nevada lakes, this species does not successfully coexist with introduced fishes, which is likely the cause for its decline. This species exhibits strong site fidelity and is subject to decline due to drying habitats (Matthews and Preisler 2010). This species no longer occurs in Nevada.

NEEDS:

Research Needs: This species may be extirpated in NV, so basic surveys of suitable habitat are needed. If no occupied habitats are located, habitat evaluation is needed to determine the likely success of transplanted individuals from nearby California populations.

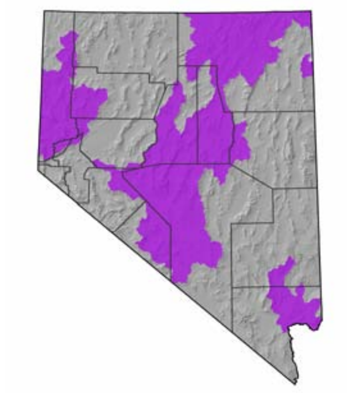
Monitoring and Existing Plans: No monitoring of this species occurs in NV. Covered in the Humboldt-Toiyabe Forest Plan Revision and the Partners in Amphibian and Reptile Conservation Amphibian and Reptile Habitat Management Guidelines.

Approach: Prohibit introductions of non-native fishes in suitable habitats. Removal of non-native fishes and re-establishment of metapopulation dynamics might reverse the decline (Knapp and Matthews 2000).

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs, Wet Meadow, Springs and Springbrooks.

western toad *Anaxyrus boreas*

Although this species is common throughout the Great Basin, there are potentially distinct and isolated endemic species cryptically found within B. boreas.



Agency Status	
NV Natural Heritage	G4S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: North and central NV.

GENERAL HABITAT AND LIFE HISTORY:

This species is found in a wide variety of habitats ranging from desert springs to mountain wetlands, and it ranges into various uplands habitats around ponds, lakes, reservoirs, and slow-moving rivers and streams. It digs its own burrow in loose soil or uses those of small mammals, or shelters under logs or rocks. The eggs and larvae develop in shallow areas of ponds, lakes, or reservoirs, or in pools of slow-moving streams.

Metamorphosed individuals feed on various small terrestrial invertebrates. Larvae filter suspended plant material or feed on bottom detritus (Nussbaum et al. 1983).

This species is sexually mature at 4-6 years. Mating and egg-laying occur between January and July depending on elevation and snowpack. Eggs are layed in still or barely moving waters of seasonal pools, ponds, streams, and small lakes. Eggs hatch in 3-10 days; may be up to 12 days in colder waters at higher elevations. Larvae metamorphose in 1-3 months; speed of larval development is dependent upon temperature.

CONSERVATION CHALLENGES:

No threats currently identified.

NEEDS:

Research Needs: Genetic analysis of potentially distinct species needs investigation and publication. Distinct and rare species arising from such an analysis would then be the focus of appropriate conservation actions.

Monitoring and Existing Plans: Some isolated populations, such as in Dixie Valley, are actively being monitored and have proactive conservation measures in place.

Approach: Additional occurrence, trend, and distribution information is needed to identify appropriate conservation approaches.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Lower Montane Woodlands, Intermountain Coniferous Forests and Woodlands, Intermountain Riparian, Aspen, Grasslands and Meadows, Springs and Springbrooks, Lakes and Reservoirs.

common chuckwalla *Sauromalus ater*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss and unsustainable levels of commercial exploitation.

Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: Populations in more remote areas are presumed stable, but could be declining in parts of its range.

DISTRIBUTION: Occurs in the Mojave Desert region of the state.

GENERAL HABITAT AND LIFE HISTORY:

Found in large boulder piles, lava flows and outcrops in the Mojave Desert.

Chuckwallas are strict herbivores, but may unintentionally ingest insects that are on their food plants. They appear to prefer flower heads or moist leaves; annuals are preferred over perennials (Brodie et al 2003) but they will consume both (Kwiatkowski et al 2009).

Active March through August, emerging from brumation in spring. Brodie et al (2003) found chuckwallas basking most often in positions that faced south within the greater southeastern hillside. To avoid predation, chuckwallas seek shelter in a rock crevice and inflate their lungs to wedge themselves tightly within the crevice. Genetic analyses determined the presence of two genetically distinct clades 1) Newberry Mountains and Goodsprings and 2) all other populations north of the Newberry Mountains. Chuckwalla populations are currently experiencing very little or no gene flow. They may be adapted to conditions particular to the mountain range they occupy and there is little evidence of migration among populations (Brodie et al 2003). Chuckwallas are long-lived lizards and take relatively longer to reach sexual maturity.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss/habitat destruction. Highly desirable species for commercial collection; vulnerable to overharvesting at easily accessible and well-known sites. This species is long-lived with a relatively low reproductive rate; therefore, it is difficult for a population to recover once numbers have declined substantially. Additionally, chuckwallas live in dense clusters in rock outcrops, so populations can be easily impacted by focused collection. The genetic analysis of Nevada chuckwalla populations found unique genetic and phenotypic traits and local population extinctions would represent a decline in the biodiversity even if populations persist elsewhere (Brodie et al. 2003).

NEEDS:

Research Needs: Determine information on population numbers, abundance, and trends. Identify the extent and impacts of collecting, and possible impacts of habitat modification resulting from unethical collecting practices. Population studies are needed to determine the threshold below which rangewide declines would threaten the species existence.

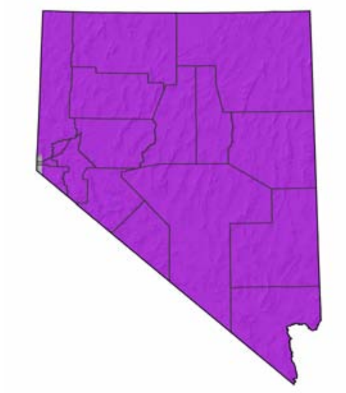
Monitoring and Existing Plans: Establish a collaborative monitoring effort among willing reptile collectors, NDOW, University of Nevada, or NV Biodiversity Initiative. Continue on-going single-species focus monitoring. This species is a Covered species under the Clark County MSHCP.

Approach: Protect large, contiguous tracts of creosote scrub habitat with suitable rock outcrops for basking and protection. Implement research needs and adjust collection laws to ensure the long-term survival of the species. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Sand Dunes and Badlands, Cliffs and Canyons.

desert horned lizard *Phrynosoma platyrhinos*

WAP 2012 species because of commercial collection pressures.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Statewide.

GENERAL HABITAT AND LIFE HISTORY:

Found on sandy flats, alluvial fans, along washes, and at the edges of dunes. Sometimes found on hardpan or among rocks, but patches of sand are generally present. Associated with creosote bush, saltbush, greasewood, cactus, and ocotillo in the Mojave Desert and with sagebrush, saltbush, and greasewood in the Great Basin.

This species is generally an ant specialist (Pianka 1991), and the bulk of their diet is made up primarily of large-bodied harvester ants (Jones and Lovich 2009). However, other items are also eaten including insects, spiders, and vegetative material.

This species is able to endure drought years by limiting above-ground activities, growth, and reproduction. The duration of its seasonal inactive period varies with local climate. In southern NV, it emerges from brumation in March; adults are less active after mid-July, but may be active on warm nights. In northern NV this species is generally inactive at night. This species buries itself in soil when inactive. Population density of 5/ha (5/2.5 acres) reported in NV (Tanner and Krogh 1973).

CONSERVATION CHALLENGES:

Vulnerable to the introduction of non-native ant species, impacts of habitat transition to annual grasses and weeds and the concomitant impacts to ant species composition, habitat destruction by ORV use, and commercial collection. Horned lizards are in high demand in the pet trade around the world and Nevada is one of very few states still permitting collection. About 5,000 horned lizards are removed from the wild in Nevada for commercial purposes each year. Horned lizards have very specific husbandry needs, which are not typically met by the majority of pet owners, which ultimately results in the premature death of many horned lizards in captivity.

NEEDS:

Research Needs: Collect demographic data to assess population and trend status. Determine local impacts of collection pressure and population responses. Determine the impacts of invasive plant transitions on ant species composition, diversity, and overall abundance.

Monitoring and Existing Plans: Not currently monitored. Southern subspecies (P. p. calidiarum) is an Evaluation Species under the Clark County MSHCP.

Approach: Establish population demographics for this species, focusing on distribution and density. Monitor collection rates and population responses to collecting at local scales. Adjust regulations based on need to maintain population viability. Partner with the Horned Lizard Conservation Society; Partners in Amphibian and Reptile Conservation; and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert Scrub and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands and Chaparral, Grasslands and Meadows, Sand Dunes and Badlands, Cliffs and Canyons, Exotic Grasslands and Forblands, Developed Landscapes, Agricultural Lands.

desert iguana *Dipsosaurus dorsalis*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss as well as unsustainable commercial collection.

Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is unknown but presumed stable.

DISTRIBUTION: In Nevada, restricted to the Mojave Desert and, in particular, to sandy habitats with low densities of creosote bushes.

GENERAL HABITAT AND LIFE HISTORY:

This species inhabits creosote bush desert with hummocks of loose sand and patches of firm ground with scattered rocks. Its northern limit appears to coincide with that of creosote bush. It occurs from below sea level in desert sinks to about 1,500 m (5,000 ft) (Stebbins 2003).

Feeds mainly on vegetable matter (e.g., leaves, buds, flowers) but also eats insects and carrion.

This species is inactive during cold weather and more tolerant of high temperatures than other lizards. It is considered the most heat-tolerant reptile in North America (Jones and Lovich 2009). Desert iguanas are most active on hot, sunny days. Remains close to hatching site (usually within 40 m (130 ft) after 3 years) (Krekorian 1984).

CONSERVATION CHALLENGES:

Vulnerable to habitat loss and overcollection in local areas. This species is closely tied to creosote bushes which are already thought to be heavily invaded by annual grasses. Loss of the shrub overstory and conversion to annual grasses is expected to reduce a desert iguana's ability to thermoregulate using natural features of the landscape (shade under bushes) despite the species' purported high tolerance to heat extremes.

NEEDS:

Research Needs: Refine species-habitat relationships and develop predictive models to support adaptive management. Determine responses and tolerance thresholds for shrub reduction in habitats transitioning to annual grass/weeds.

Monitoring and Existing Plans: Not currently monitored. Covered species under the Clark County MSHCP.

Approach: Focus on research needs. Generate rough population estimates through a multi-species reptile monitoring program; monitor collection rate and population response to collecting at local scale. Adjust regulations based on need to maintain population viability. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Sand Dunes and Badlands, Cliffs and Canyons.

desert night lizard *Xantusia vigilis*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Southern NV.

GENERAL HABITAT AND LIFE HISTORY:

This species is found primarily in desert habitats, but may also range up into adjacent chaparral and lower pine woodland. It lives in and under decaying Joshua trees and various other species of Yucca, Nolina, prickly pear, and pine logs (Jones and Lovich 2009). Also found under rocks and in rock crevices, beneath cow chips, soil-matted dead brush and other debris, and woodrat nests (Stebbins 2003 and Jones and Lovich 2009).

Eats insects, spiders, and other arthropods (Stebbins 2003) found by burrowing under plant litter and desert debris.

Common night lizards are small in size and very secretive in nature, making them difficult to survey. They are seldom found in the open away from cover (Stebbins 2003) and they may live under the same cover for much of their life (Jones and Lovich 2009). In their microhabitat they have few predators and achieve population densities of at least 47 lizards per hectare (Jones and Lovich 2009). They are diurnal and crepuscular, but nocturnal during the warmest summer months. Night lizards have vertical pupils which help their sight in low light conditions.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss and conversion due to development, fire, and climate change impacts, particularly with respect to its association with Joshua tree and heavy desert floor litter.

NEEDS:

Research Needs: Determine species status and trend; refine species-habitat relationships; develop predictive models with regard to responses to habitat transitions to annual grasses and weeds; determine management needs.

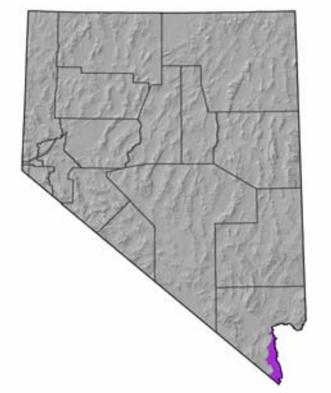
Monitoring and Existing Plans: Not currently monitored. Evaluation Species under the Clark County MSHCP.

Approach: Focus on research needs; generate rough occupancy rates.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands, Sand Dunes and Badlands, Cliffs and Canyons.

desert rosy boa *Lichanura trivirgata*

WAP 2012 species because it occurs in isolated populations that leave the species vulnerable to decline especially with respect to climate change and collection. Known from only one location in Nevada.



Agency Status	
NV Natural Heritage	G4G5S1
USFWS	No Status
State Prot	Protected Reptiles NAC 503.080.1
CCVI	Presumed Stable

TREND: The status and trend of this species in Nevada is unknown although it is considered vulnerable in both CA and AZ. There is only one official record of the species in the Newberry Mountains (Mulkes 2011). It was listed as a Protected Reptile under NAC 503.080.1 in December 2011.

DISTRIBUTION: Distribution is not fully known in Nevada; however, rosy boas are often reported to be uncommon (Brennan and Holycross 2006, Stoops and Wright 2005, Endemic Species Committee 1982). One recently discovered as the first state record in the Newberry Mountains at Christmas Tree Pass on 30 May 2010 (Mulkes 2011). There were very few previous records reported (Grate 1981); none of which could be verified. Stebbins (2003) notes the rosy boa distribution is spotty, especially in lower arid parts of its range. The limited data suggest that isolated populations exist in NV that are not connected to the remaining portion of its range in CA and AZ.

GENERAL HABITAT AND LIFE HISTORY:

The rosy boa is one of only two boa species native to the U.S. Rosy boas are associated with arid and semiarid scrublands, hillsides, rocky deserts, desert oases, canyons, talus, and other such rock-strewn regions. Often occurring near canyon and desertland streams, but they are by no means restricted to such locales. Capable of burrowing but often merely seek cover beneath surface debris, amidst rocks, or in the middens of burrowing rodents (Bartlett and Bartlett 2009b).

The rosy boa primarily feeds on small rodents (especially nestling mice), and occasionally shrews, nestlings of ground-dwelling birds, lizards, smaller snakes, salamanders, and anurans (Bartlett and Bartlett 2009b).

Rosy boas are largely crepuscular and nocturnal, but may be active by day during the breeding season. Rosy boas are live-bearing snakes (Bartlett and Bartlett 2009b).

CONSERVATION CHALLENGES:

Other states have expressed concern that rosy boas are being collected in large numbers from the wild in an unsustainable fashion (Fisher 2011). Only one has been recently discovered in Nevada, and population connectivity to known inhabited areas is unknown. Vulnerability to climate change habitat transitions are difficult to predict. Conservation concern exists across the species' range relative to impacts from roads, habitat fragmentation, conversion and loss, increased fire frequency, urbanization, poaching, lack of knowledge, and regulatory protection (Fisher 2011).

NEEDS:

Research Needs: Research on distribution and status in Nevada is needed, along with vulnerability to climate change-induced habitat transition and loss.

Monitoring and Existing Plans: Species is not currently monitored and does not occur within any other existing plans. Appropriate regulations should be in place to limit collection. Proactive steps need to be taken to ensure appropriate management of rosy boas and their habitat across their range.

Approach: Determine population status and distribution in Nevada and vulnerability to climate change; partner with California and Arizona in the development of a rangewide assessment and conservation strategy.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Cliffs and Canyons.

Gila monster — *Heloderma suspectum*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss and poaching.

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Reptiles NAC 503.080.1
CCVI	Highly Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Occurs within the Mojave Desert in southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Usually found in desert scrub habitats, semi-desert grassland and (more rarely) woodland communities along mountain foothills. Gila monsters frequent canyons or adjacent rocky slopes and occasionally open valleys. Their presence depends upon microhabitat features such as rock crevices, boulders, burrows, and packrat middens which this species uses for shelter. Gila monsters will also dig their own burrows, which are extremely important as Gila monsters spend most of their time in their burrows and show great site fidelity to familiar habitats and shelters (Beck 2009).

Gila monsters will forage long distances in search of eggs or young in vertebrate nests, primarily reptile and bird eggs and juvenile mammals including cottontails and mice (Beck 2009).

This is the only venomous lizard native to the U.S. It is most active from late April through June; activity rapidly declines in July. Although active, as much as 97% of its time is spent in shelters and less than 13% of its energy budget is spent on above-ground activities (Beck 2005). Water availability is critical and individuals are often active after summer rains. Gila monsters have fairly high rates of evaporative water loss for a desert lizard; however, water can be stored in the urinary bladder and later absorbed, which helps prevent dehydration during hot, dry periods. This species is long-lived with a low reproductive rate. It can survive long periods without food by storing extra fat in the tail. Gila monsters appear to be solitary but may use communal overwintering sites. They may migrate locally (usually < 1 km (0.6 mile)) between highland winter retreat and lowland summer habitat (Lowe et al. 1986). However, Gila monsters may travel distances in excess of one kilometer per day in search of food and mates (Beck 2009).

CONSERVATION CHALLENGES:

Vulnerable to habitat loss, fragmentation, and degradation, particularly along the edges of their distribution. Degradation may occur as a result of exotic species invasion of their habitat, OHVs, and other forms of recreation at heavy levels. This species is long-lived with a relatively low reproductive rate; therefore, it is difficult for a population to recover once numbers have declined substantially. Though it is illegal to collect without a permit, concerns over illegal take linger.

NEEDS:

Research Needs: Comprehensive ecological/life history studies (e.g., distribution, habitat, population, life history) are needed in NV. Population studies are needed to determine the threshold below which rangewide declines would threaten the species existence.

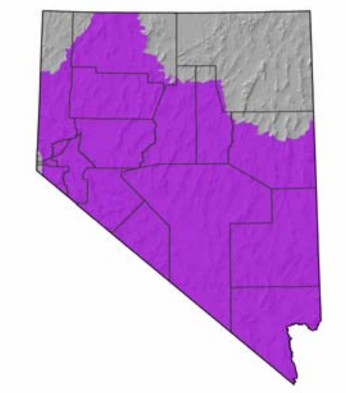
Monitoring and Existing Plans: Currently there is a collaborative monitoring effort between NDOW, the University of Nevada, and Clark County MSHCP (Evaluation Species); single species-focus monitoring.

Approach: Identify and describe suitable habitat for this species in Nevada and develop management guidelines based on suitable habitat parameters. Maintain prohibitions against indiscriminate collection and unnecessary killing.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Cliffs and Canyons.

Great Basin collared lizard *Crotaphytus bicinctores*

WAP 2012 species because of commercial collection pressures.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Statewide with the exception of the Carson Range, and northwest and northeast corners of the state.

GENERAL HABITAT AND LIFE HISTORY:

Occurs mainly in xeric, sparsely vegetated, rocky areas on alluvial fans, lava flows, hillsides, rocky plains, and in canyons (Jones and Lovich 2009). It perches atop rocks and hides under rocks or in rodent burrows (McGuire 1996). It can be found from sea level to about 2,280 m (7,500 ft) (Stebbins 2003).

This species eats a wide variety of insects, spiders, lizards, and some plant materials (Stebbins 2003).

Inactive during cold winter weather; duration of inactive period varies with local climate. Activity begins as early as March in AZ (McGuire 1996) while populations in northwest NV are active by mid-April (Jones and Lovich 2009).

CONSERVATION CHALLENGES:

Vulnerable to local population decimation by excessive collection. This species is heavily collected for commercial purposes in some areas without much regulatory collection protections or monitoring.

NEEDS:

Research Needs: Develop a responsive status and trend monitoring protocol; refine habitat relationships; develop predictive models; determine response to collection pressure.

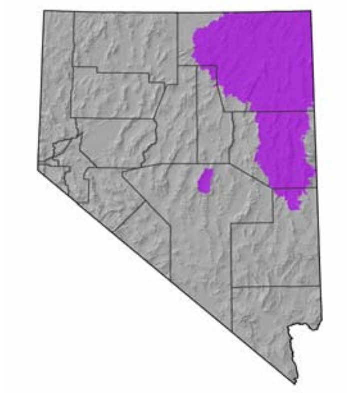
Monitoring and Existing Plans: Covered species under the Clark County MSHCP.

Approach: Implement research needs. Generate rough population demographics, determine population trend and adjust allowable harvest based on demonstrated need. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands and Chaparral, Sand Dunes and Badlands, Cliffs and Canyons, Exotic Grasslands and Forblands.

greater short-horned lizard *Phrynosoma hernandesi*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5S3S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Population size and trend are unknown.

DISTRIBUTION: Found in the northern and central part of the state, some isolated populations reported. The majority are found at higher elevations from the Toiyabe Range east to the Snake Range.

GENERAL HABITAT AND LIFE HISTORY:

Ranges from semiarid plains to high mountains (600-3,200m). Greater short-horned lizards occupy a wide variety of habitats including sagebrush, and open pinyon-juniper, pine-spruce, and spruce-fir forests. Substrate may be stony, sandy, or firm, but some fine loose soil is usually present.

This species eats primarily ants, and beetles also contribute to a substantial portion of their diet.

More cold tolerant than other horned lizards. Because they live at higher elevations they have very short growing seasons and females are not sexually mature until the season after their second brumation (Jones and Lovich 2009).

CONSERVATION CHALLENGES:

Although most populations are not threatened, this species is often not discerned from the desert horned lizard, one of the most commercially collected reptiles in the state.

NEEDS:

Research Needs: Refine species-habitat relationship; develop predictive model to inform adaptive management. Determine prey species composition (ants, etc). Identify response and tolerance thresholds to habitat transitions to annual grass/forb domination, particularly with respect to changes in ant species composition and abundance. Determine breeding/parturition/juvenile habitat ecology needs.

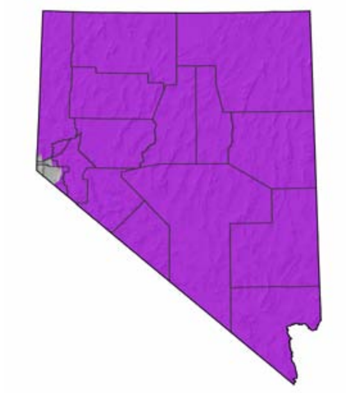
Monitoring and Existing Plans: Not within any other existing plans.

Approach: Through species-specific monitoring, generate rough population estimates and local trends; monitor collection rate and population response to collecting at local scale. Adjust regulations based on need to maintain population viability. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Grasslands and Meadows, Sand Dunes and Badlands, Cliffs and Canyons.

long-nosed leopard lizard *Gambelia wislizenii*

WAP 2012 species because of commercial collection pressures.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Statewide.

GENERAL HABITAT AND LIFE HISTORY:

This species is found in sandy and gravelly desert and semidesert areas with scattered shrubs or other low plants (e.g., bunch grass, alkali bush, sagebrush, creosote bush), especially areas with abundant rodent burrows. The long-nosed leopard lizard avoids densely vegetated areas that can interfere with running. Occurs from sea level to approximately 1,800 m.

The long-nosed leopard lizard eats insects, spiders, lizards, snakes, small rodents, and soft leaves, blossoms, and berries (Stebbins 2003).

This species is ground dwelling but sometimes climbs into bushes. When threatened, it typically runs to base of a shrub and remains motionless. When inactive, it occupies burrows (Hammerson 1982, Nussbaum et al. 1983). Territorial behavior apparently does not occur in long-nosed leopard lizards and, other than interactions associated with mating, adults appear to be rather oblivious of each other (McCoy 1967). Some individuals appear to be somewhat nomadic. Population density in NV was about 5/ha (5/2.5 acres) (Tanner and Krogh 1974). The long-nosed leopard lizard is not active in cold weather and is active mainly May-August in the north (Hammerson 1982), and late March or early April through late August-late October in the south (Mitchell 1984, McGuire 1996). Those individuals active in late summer are mainly hatchlings.

CONSERVATION CHALLENGES:

Vulnerable to local population decimation by excessive collection.

NEEDS:

Research Needs: Research is needed to determine response to collection pressure and determine sustainable harvest levels. Research is also needed to determine responses and tolerance thresholds to habitat transitions to uncharacteristic classes, particularly annual grass, weeds, and rabbitbrush.

Monitoring and Existing Plans: This species is a Covered Species under the Clark County MSHCP.

Approach: To help regulate harvest based on demonstrated need, research is needed to determine rough population demographics, generate a population trend, and determine sustainable harvest levels. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Grasslands and Meadows, Sand Dunes and Badlands, Exotic Grasslands and Forblands, Developed Landscapes, Agricultural Lands.

long-tailed brush lizard *Urosaurus graciosus*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Highly Vulnerable

TREND: The trend for this species is unknown.

DISTRIBUTION: Southern NV.

GENERAL HABITAT AND LIFE HISTORY:

This species occurs in desert washes and drainages and flat areas with loose sand and gravel from near sea level to approximately 1,070 m. It is often found on the branches of shrubs and trees including creosote bush, desert willow, palo verde, smoke tree, salt bush, galleta grass, mesquite, and catclaw acacia. May also utilize introduced fan palms and tamarisk (Jones and Lovich 2009, Stebbins 2003).

The long-tailed brush lizard eats insects (beetles, ants, bees, hemipterans, etc.), spiders, and some plant material (Stebbins 2003).

The long-tailed brush lizard is usually found on branches of trees and shrubs, and may dig into sand or use a burrow at night. It is a heat-tolerant species, but may seek shelter in the sand or in burrows during the hottest part of the day (Jones and Lovich 2009).

CONSERVATION CHALLENGES:

Vulnerable to decline due to large-scale habitat conversion and loss.

NEEDS:

Research Needs: Research is needed to clarify basic distribution and status in NV and to refine a species-habitat relationship to aid in developing a predictive model. Also identify responses and tolerance thresholds to habitat transitions to uncharacteristic classes, particularly annual grass, exotic tree, and entrenched (both desert riparian classes).

Monitoring and Existing Plans: Not within any other existing plans.

Approach: Implement research focusing on status and distribution, and basic natural history. Monitor response to habitat transitions through occupancy modeling. Additional recommendations include developing management guidelines within the context of a multi-species reptile management plan.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian.

Mohave (or Mojave) shovel-nosed snake *Chionactis occipitalis*

WAP 2012 species because of current and increasing habitat development and fragmentation especially in consideration of alternative energy development and large-scale solar power plants.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Flat areas with sandy soils in the Mojave Desert of southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Habitat of this burrowing snake consists of sparsely vegetated (mesquite-creosote bush, desert grasses, cactus) desert, including rocky slopes, dunes, washes, and sandy flats (Stebbins 2003). Prefers flat areas with sandy soils.

The western shovel-nosed snake feeds on various life stages of insects (larvae, pupae, and adults). Such insects include spiders, scorpions, and centipedes.

This snake is nocturnal. It has been observed on the surface during the day only a few times, usually coiled under a bush. Much of its activity is probably subterranean. It is active most of the year in the south and during the warmer months in the north and is non-migratory (Cowles 1941, Stebbins 1954). Snakes often lie just under the surface of the sand where they can be heated by the warmth of the sun without exposing themselves (Stebbins 1954). It breeds in the spring with an average of 2-4 eggs laid underground (Cowles 1941).

CONSERVATION CHALLENGES:

Vulnerable to loss of habitat, fragmentation and loss of connectivity due to development (i.e., urban, suburban), especially in consideration of alternative energy development and large-scale solar power plants. Vulnerable to excessive OHV recreation in loose sandy soils.

NEEDS:

Research Needs: Determine status and distribution, develop rough population indices, monitor habitat integrity and connectivity.

Monitoring and Existing Plans: This species is not currently monitored.

Approach: This is a secretive, diminutive snake about which very little is known. Obtaining better distribution information will help guide management decisions as they relate to development, OHV use, and climate change. Work with solar project proponents to develop appropriate mitigation actions as necessary.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Sand Dune and Badlands, Cliffs and Canyons.

Mojave desert tortoise *Gopherus agassizii*

WAP 2012 species because it is listed as threatened under the Endangered Species Act and is declining due to habitat loss and fragmentation, disease, and direct mortality by humans.

Agency Status	
NV Natural Heritage	G3S2S3
USFWS	LT
BLM-NV	Sensitive
USFS-R4	Threatened
State Prot	Threatened Reptiles NAC 503.080.2
State Prot	Nevada State Emblems
IUCN	Vulnerable
CCVI	Presumed Stable

TREND: Likely declining long-term. Desert tortoises are long-lived, which requires longer monitoring periods to obtain accurate trend estimates. Rangewide monitoring reports suggest short-term fluctuations in Recovery Units in NV (USFWS 2006, 2009, 2010c, 2011b).

DISTRIBUTION: Found in the Mojave Desert, southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Occupies a variety of habitats from flats and slopes dominated by creosote bush scrub at lower elevations to rocky slopes in blackbrush and juniper woodland ecotones (transition zone) at higher elevations. Requires soils that are friable enough for digging burrows, but firm enough so that burrows do not collapse (USFWS 2008). Also uses caliche caves as shelters.

Eats a wide variety of herbaceous vegetation, particularly grasses and the flowers of annual plants. They also forage on perennial grasses, woody perennials, cacti, and non-native species such as red brome and red-stem filaree (USFWS 2008).

Long-lived (70-100 yrs) and slow-growing, they reach sexual maturity at 13-20 years. Desert tortoises have low reproductive rates. Much of their life is spent in burrows. In late winter or early spring they emerge from their overwintering burrows and remain active through the fall (USFWS 2008).

CONSERVATION CHALLENGES:

Vulnerable to habitat loss/fragmentation/conversion, disease, poaching, and direct mortality/losses caused by humans (e.g., road kills, OHVs). Releases of captives into wild populations may be detrimental. The recent taxonomic split places the formerly recognized Mojave population of desert tortoise into its own species, Mojave desert tortoise (Gopherus agassizii) while desert tortoises in the Sonoran Desert are now referred to as Morafka's desert tortoise (G. morafkai) (Murphy et al. 2011); therefore, the species' resiliency to change must be evaluated now at a significantly restricted scale.

NEEDS:

Research Needs: Regular population monitoring is needed. Active management may be required to maintain the viability of relatively small populations. Fences and culverts may be important to reducing road mortalities (Ruby et al. 1994). Research should focus on minimum viable population sizes, nutrititional forage requirements, microhabitats of suitable nesting areas as well as other life history needs. Impacts of unwanted pets to wild populations needs to be addressed.

Monitoring and Existing Plans: Monitoring is being implemented by the Bureau of Land Management, National Park Service, and affected Department of Defense military reservations as well as some state agencies under the auspices of the 1995 DoD/DOI Mojave Desert Ecosystem Initiative. Covered species under the LCR MSCP, Nye County HCP, Lincoln County HCP, and Clark County MSHCP. Managed under the Mojave Desert Tortoise Recovery Plan (USFWS 2011b).

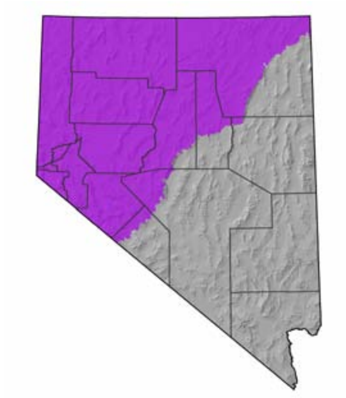
WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian.

Approach: Protect large tracts of suitable habitat well dispersed throughout the range. Continue habitat restoration and improvements and continue implementing actions within the Recovery Plan. Investigate the need to modify regulations pertaining to pet desert tortoises.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian.

northern rubber boa *Charina bottae*

WAP 2012 species because it requires mesic microhabitats within the Great Basin that are vulnerable to drying due to climate change and is reliant upon aspen riparian areas, a vulnerable habitat-type.



Agency Status	
NV Natural Heritage	G5S3S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Population size and trend are unknown.

DISTRIBUTION: The rubber boa is closely associated with riparian areas in Nevada, although periodically found in sagebrush steppe.

GENERAL HABITAT AND LIFE HISTORY:

Rubber boa habitat includes woodlands, forest clearings, patchy chaparral, meadows, and grassy savannas, generally not far from water; also riparian zones in arid canyons and sagebrush in some areas (Nussbaum et al. 1983, Brown et al. 1995, St. John 2002, Stebbins 2003). Generally this snake is found in or under rotting logs or stumps, under rocks or in crevices, or under the bark of dead fallen trees.

The rubber boa diet includes mice, shrews, lizards, lizard eggs, snakes, and small birds. Kills prey by constriction.

Rubber boas are largely crepuscular and nocturnal, but may be active by day during the breeding season. Rubber boas are live-bearing (Bartlett and Bartlett 2009b).

CONSERVATION CHALLENGES:

Possibly vulnerable to excessive collection due to its market desirability and relatively high wholesale prices per specimen. May face additional pressure as is requires mesic microhabitats within the Great Basin that are vulnerable to drying due to climate change, particularly aspen riparian areas.

NEEDS:

Research Needs: Research should focus on determining current population status and trend as well as response and tolerance thresholds to habitat transitions and loss, particularly aspen loss and riparian entrenchment.

Monitoring and Existing Plans: This species is not currently actively monitored for or included in any conservation plans.

Approach: Protect and maintain quality habitat within riparian zones including moist soils, healthy meadows, and natural debris such as rotting logs, stumps, and fallen trees. Determine rough population status and trend through occupancy modeling.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Grasslands and Meadows, Cliffs and Canyons.

Panamint alligator lizard *Elgaria panamintina*

WAP 2012 species because it occurs in only a small portion of the state and its preferred habitat is vulnerable to degradation

Agency Status	
NV Natural Heritage	G2G3SNA
USFWS	No Status
IUCN	Vulnerable
CCVI	Presumed Stable

TREND: Population status and trend is unknown.

DISTRIBUTION: This species occurs in the Panamint Mtns., southwestern NV.

GENERAL HABITAT AND LIFE HISTORY:

The Panamint alligator lizard has been observed in dry washes and on rocky slopes in creosote bush scrub, desert scrub, and lower pinyon-juniper woodland from 760 to 2,290m. It occurs most frequently in isolated canyons with riparian and permanent spring habitats where there is a thick layer of plant debris for refuge. Riparian habitats include willow species, wild grape, monkeyflower, and maidenhair fern. Xeric sites are dominated by creosote bush, sagebrush, shad scale, buckwheat, Encelia, and cacti (Jones and Lovich 2009).

This species eats insects, spiders, and other arthropods (Stebbins 2003).

Due to its secretive nature, not much is known about the ecology of the Panamint alligator lizard. It is secretive and spends much of its time in rockslides and dense plant growth. Activity peaks in June; individuals may be seen basking in late afternoon. It is primarily diurnal, but sometimes nocturnal (Stebbins 2003, Jones and Lovich 2009).

CONSERVATION CHALLENGES:

This species' entire range is very limited and it occurs in only a small portion of Nevada. May be vulnerable to habitat degradation and conversion via mining, unsustainable grazing, and excessive OHV activities.

NEEDS:

Research Needs: Basic distribution and status in the state.

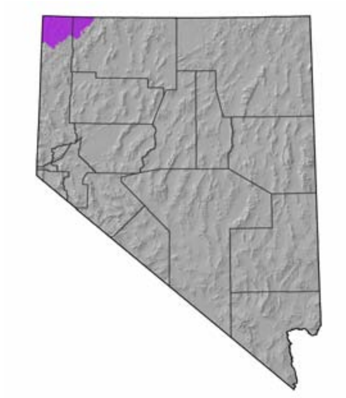
Monitoring and Existing Plans: This species is not currently monitored and not within any other existing plans.

Approach: Conduct surveys to determine distribution and status. Partner with California Department of Fish and Game to gather information to determine conservation vulnerability and management actions if necessary.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands and Chaparral.

pygmy short-horned lizard *Phrynosoma douglasii*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5SNR
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: The trend for this species is unknown.

DISTRIBUTION: Occurs in extreme northwestern portion of the state.

GENERAL HABITAT AND LIFE HISTORY:

The pygmy short-horned lizard's habitat ranges from semiarid plains of sagebrush and bunch grass, to pinyon-juniper woodlands, to pine forests in high mountains. It is usually found in open, shrubby, or openly wooded areas with sparse vegetation at ground level. The soil may vary from rocky to sandy to hardpan, but pockets of fine loose soil or sand are typically present for burrowing. Occurs from 300 to 2,200 m.

This species primarily eats ants but also consumes many non-ant insects and arthropods including grasshoppers, beetles, spiders, and true bugs (Jones and Lovich 2009).

Population densities vary greatly, ranging from less than two up to 15 individuals/hectare (Jones and Lovich 2009). Though adapted to living in a colder environment than other species of horned lizard, the pygmy short-horned lizard is inactive during cold weather or extended periods of heat. When inactive it burrows into soil or occupies rodent burrows. This species is live bearing (Stebbins 2003).

CONSERVATION CHALLENGES:

This species is poorly understood. Assumed to be vulnerable to large-scale habitat conversion and loss.

NEEDS:

Research Needs: Research is needed on the status and distribution of this species. Habitat relationships need to be better described. It is also necessary to determine species distribution as it relates to P. hernandesi and to develop predictive models.

Monitoring and Existing Plans: Other than being an NDOW single species focus, this species is not within any other existing plans.

Approach: Continue single-species investigations; develop rough population estimate and trend via occupancy modeling; identify response and tolerance threshold to habitat transitions to uncharacteristic classes, particularly annual grass and rabbitbrush, with an emphasis on noting changes in ant species composition and abundance.

WAP HABITAT LINKS: Sagebrush, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Grasslands and Meadows.

ring-necked snake *Diadophis punctatus*

WAP 2012 species because it requires mesic microhabitats in the Mojave Desert that are vulnerable to drying due to climate change.

Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Population size and trend are unknown.

DISTRIBUTION: Found in mesic and riparian habitats in the Mojave Desert; Snake and Schell Creek Ranges in eastern NV; purported to occur in the Sierra Nevada and extreme border of western NV from Honey Lake to Surprise Valley on most range maps.

GENERAL HABITAT AND LIFE HISTORY:

This snake occurs in forests, woodlands, grassland, chaparral, and riparian corridors in arid regions (Stebbins 2003). Habitats are moist, at least seasonally. One or multiple individuals often are found near abandoned buildings and in junk piles in wooded areas.

The ring-necked snake eats earthworms, slugs, small salamanders, frogs, lizards, snakes and various other small invertebrates.

Ring-necked snakes are primarily nocturnal or highly crepuscular, though some diurnal activity has been observed.

CONSERVATION CHALLENGES:

Vulnerable to the drying effects of climate change on mesic microhabitats, including desertification of riparian habitats.

NEEDS:

Research Needs: Research is needed to determine status and distribution, particularly along the NV-CA border; describe habitat relationships; and determine population viability. Analysis of habitat integrity and connectivity is also needed to manage for possible movement responses to climate change.

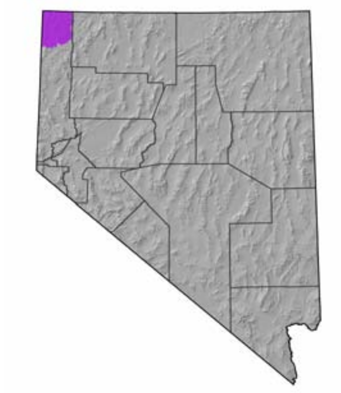
Monitoring and Existing Plans: This species is a Clark County MSHCP Evaluation species (Regal ring-necked snake subspecies).

Approach: Status, distribution, ecology, and taxonomic status investigations need to be performed to determine subspecies diversity, metapopulation connectivity, and responses to climate change-induced habitat transition and loss.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Intermountain Riparian, Wet Meadow, Springs and Springbrooks, Cliffs and Canyons.

Shasta alligator lizard *Elgaria coerulea shastensis*

WAP 2012 species because it requires mesic microhabitats in the Great Basin that are vulnerable to drying due to climate change.



Agency Status	
NV Natural Heritage	G5T4S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Reptiles NAC 503.080.1
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Small, probably disjunct populations of this subspecies occur in the northwest corner of the state.

GENERAL HABITAT AND LIFE HISTORY:

Generally found in cooler, damper places in a variety of forested habitats and montane chaparral. Also found in grassy grown-over areas at margins of woodlands, in clearcuts, near streams, rock outcrops, and talus. Cover is provided by surface objects such as rocks, logs, dense vegetation, and human debris. Refuge may also be taken in crevices, rock fissures, and mammal burrows.

This subspecies is known to eat a variety of small invertebrates, including insects, spiders, millipedes, slugs, snails, and worms. It will also eat small lizards and small mammals and will occasionally feed on bird eggs and young birds.

Alligator lizards are generally secretive, tending to hide in brush or under rocks, although they are often seen foraging out in the open or on roads in the morning and evening.

CONSERVATION CHALLENGES:

Small populations vulnerable to habitat loss and fragmentation.

NEEDS:

Research Needs: Research is needed on population size, distribution, and viability.

Monitoring and Existing Plans: This subspecies is not currently monitored and does not occur within any other existing plans.

Approach: Develop a single-species discovery survey project, determine degree of conservation risk and develop conservation strategy based on need. Monitor responses to climate change-induced habitat transitions.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Grasslands and Meadows.

sidewinder — *Crotalus cerastes*

WAP 2012 species because of current and increasing habitat development and fragmentation especially in consideration of alternative energy development and large-scale solar power plants.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: The trend for this species is unknown.

DISTRIBUTION: Sandy soils of the Mojave Desert in southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

This venomous snake generally inhabits open desert terrain with fine windblown sand, desert flats with sandy washes, or sand dunes sparsely vegetated with creosote bush or mesquite. Sometimes it occurs in rocky or gravelly sites (Lowe et al. 1986, Ernst and Ernst 2003, Stebbins 2003, Campbell and Lamar 2004). In the Mojave Desert, snakes concentrated near washes and areas of relatively dense vegetation where mammal burrows are common (Brown and Lillywhite 1992), though in other areas this snake has been found to be more common where vegetation is sparse.

The sidewinder preys mainly on lizards, pocket mice, kangaroo rats, and other small mammals. In many areas lizards are most important. Occasionally, it takes small birds and snakes. It is an active forager, but it also waits under bushes for prey, partially buried in sand.

This snake is primarily nocturnal, but in the early spring it is active at dusk and even occasionally during the day. It is active from early to mid-spring until late summer or early fall. Populations of southerly or warmer areas become active earlier. It sometimes ceases activity in mid-summer, when temperatures are highest (Stebbins 1954, Klauber 1972). It is not known to migrate.

CONSERVATION CHALLENGES:

No specific threats have been identified. Potential concern may exist with habitat loss or fragmentation, especially in consideration of alternative energy development and large-scale solar power plants, or other land development.

NEEDS:

Research Needs: Information on the status, trend and distribution of this species is needed. Habitat integrity and connectivity analysis is also needed.

Monitoring and Existing Plans: The sidewinder is a Clark County MSHCP covered species.

Approach: Determine population status, distribution, ecology, taxonomic status, and conservation risk. Develop conservation strategy as needed. Work with solar energy project proponents to develop and implement appropriate mitigation actions.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Grasslands and Meadows, Sand Dunes and Badlands.

Sierra alligator lizard *Elgaria coerulea palmeri*

WAP 2012 species because it requires mesic microhabitats in the Sierras that are vulnerable to drying due to climate change.

Agency Status	
NV Natural Heritage	G5T4S2S3
USFWS	No Status
State Prot	Protected Reptiles NAC 503.080.1
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Found only in the Sierra Nevada and immediately adjacent ranges in the western part of the state.

GENERAL HABITAT AND LIFE HISTORY:

Generally found in cooler, damper places in a variety of forested habitats and montane chaparral. Also found in grassy grown-over areas at margins of woodlands, in clearcuts, near streams, rock outcrops, and talus. Cover is provided by surface objects such as rocks, logs, dense vegetation, and human debris. Refuge may also be taken in crevices, rock fissures, and mammal burrows.

This subspecies is known to eat a variety of small invertebrates, including insects, spiders, millipedes, slugs, snails, and worms. It will also eat small lizards and small mammals and will occasionally feed on bird eggs and young birds.

Alligator lizards are generally secretive, tending to hide in brush or under rocks, although they are often seen foraging out in the open or on roads in the morning and evening.

CONSERVATION CHALLENGES:

Restricted range and habitat pressures due to increased urbanization.

NEEDS:

Research Needs: Research needs include status and distribution studies and a predictive model to guide adaptive management.

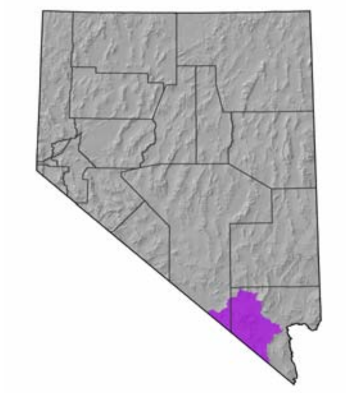
Monitoring and Existing Plans: NDOW partnership with Forest Service - Lake Tahoe Basin Management Unit; single species focus. Not within any other existing plans.

Approach: Investigate population distribution, status, and conservation risk. Develop conservation strategy as needed. Monitor responses to climate change-induced habitat transitions, particularly those that desiccate microhabitats.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral, Intermountain Riparian, Grasslands and Meadows, Aspen, Alpine and Tundra, Cliffs and Canyons.

Smith's black-headed snake *Tantilla hobartsmithi*

WAP 2012 species because it has fragmented populations and its habitat is vulnerable to deterioration, especially with respect to climate change.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Presumed Stable

TREND: Population size and trend are unknown.

DISTRIBUTION: Southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Smith's black-headed snake habitat includes pinyon-juniper woodland, chaparral-woodland, riparian woodland, mesquite-yucca grassland, sagebrush-greasewood, cedar-ocotillo, persimmon-shin oak, mesquite-creosote bush, and cedar-savanna (Cole and Hardy 1983, Werler and Dixon 2000, Stebbins 2003).

Eats insect larvae (beetles, caterpillars, etc.), centipedes, and millipedes (Cole and Hardy 1981).

Smith's black-headed snakes are nocturnal and are active throughout the year. Although a secretive, semifossorial species, it may travel in the open at night. They may experience brief periods of inactivity in extreme weather conditions. Lays up to three eggs per season (Stebbins 2003).

CONSERVATION CHALLENGES:

Apparently fragmented populations are vulnerable to habitat transitions to uncharacteristic classes, particularly annual grasses with no shrub layer. Population connectivity could be impacted by large-scale solar energy field development if no attention is paid to strategic placement.

NEEDS:

Research Needs: Determine status and distribution of this species in Nevada. Identify response and tolerance thresholds to habitat transitions into uncharacteristic classes (annual grasses with no shrub layer).

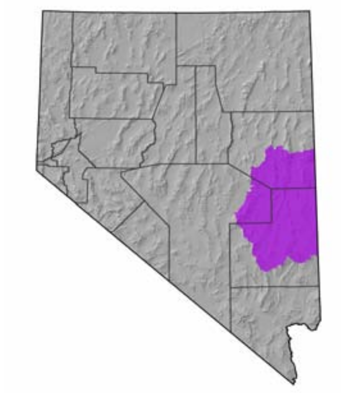
Monitoring and Existing Plans: Species is not currently monitored and does not occur within any other existing plans.

Approach: Investigate population distribution, status, and conservation risk. Develop conservation strategy as needed. Monitor responses to climate change-induced habitat transitions, particularly those that desiccate microhabitats.

WAP HABITAT LINKS: Salt Desert Shrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Intermountain Riparian, Lower Montane Woodlands and Chaparral.

Sonoran mountain kingsnake *Lampropeltis pyromelana*

WAP 2012 species because it occurs in isolated populations that leave the species vulnerable to decline especially with respect to climate change, groundwater withdrawals, and poaching.



Agency Status	
NV Natural Heritage	G4G5S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Reptiles NAC 503.080.1
CCVI	Highly Vulnerable

TREND: This species is rare and localized. Its population size and trend are unknown, though there is some evidence of increased collection pressures.

DISTRIBUTION: This species exists in isolated populations in east-central NV mountain ranges in White Pine and Lincoln counties. One voucher specimen was collected from the Virgin Range in Clark County.

GENERAL HABITAT AND LIFE HISTORY:

Sonoran mountain kingsnake habitats are primarily rocky, montane, and often near streams or springs, but also include lower elevations in mesic canyons (Degenhardt et al. 1996, Tanner 1983, Ernst and Ernst 2003, Stebbins 2003). Appears to be most abundant where surface water and riparian vegetation occur; however, does not necessarily require surface water (nafha.org). Vegetation may include pinyon-juniper woodland, oak-juniper woodland, pine-oak woodland, pine-Douglas-fir woodland, or chaparral (Stebbins 2003). During daylight hours, this snake may be found among rocks, logs, or dense clumps of vegetation, under objects, or exposed.

This snake eats lizards, frogs, snakes, and small mammals.

The Sonoran mountain kingsnake is primarily diurnal and is active from late spring to early fall, but is inactive during the cold winter months. Prefers cloudy or shady conditions for surface activity (nafha.org). Females lay a clutch of two to nine eggs during June-July (Stebbins 2003).

CONSERVATION CHALLENGES:

Isolated populations in montane riparian habitats make this species vulnerable to extinction in NV, especially with respect to climate change. Vulnerable to landscape level disturbances such as wildfire, habitat fragmentation, and groundwater withdrawals. Also, its unique coloration makes it a highly desirable species for collectors and fanciers despite prohibition of collection.

NEEDS:

Research Needs: Connectivity of NV populations to more robust populations located in other portions of its range have not been documented. Research is needed to determine status and distribution, movement patterns and home ranges, describe habitat relationships, determine population abundance and viability, and to build a predictive model to guide management. Also needed is genetic analysis to clarify population relationships.

Monitoring and Existing Plans: This species is part of Clark County's MSHCP. NDOW and Great Basin National Park conduct annual surveys for this species.

Approach: Investigate population distribution, status, and conservation risk. Develop conservation strategy as needed. Monitor responses to climate change-induced habitat transitions.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Cliffs and Canyons.

spotted leaf-nosed snake *Phyllorhynchus decurtatus*

WAP 2012 species because of current and increasing habitat fragmentation, especially in consideration of alternative energy development and large-scale solar power plants.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Presumed Stable

TREND: This species status and trend is unknown.

DISTRIBUTION: Mojave Desert of southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Habitat of the spotted leaf-nosed snake generally consists of rocky, gravelly, or sandy desert plains or dunes with creosote bush (Stebbins 2003). This snake may burrow into loose soil or sand, and it hides under rocks or surface debris or in abandoned rodent burrows (Stebbins 1954, Ernst and Ernst 2003).

The spotted leaf-nosed snake eats squamate eggs and small lizards (e.g., banded geckos, or just the tail) (Gardner and Mendelson 2003). It may occasionally eat lizards (Brennan discoverlife.org).

This snake is nocturnal. It is active in the early evening during mild to warm weather. Greatest activity occurs from April to July (Stebbins 1954). It uses its enlarged rostral scale for burrowing and spends the majority of its time under the soil. It hibernates during the cold months of late fall and winter and is commonly encountered on the surface at night in June (Brennan discoverlife.org).

CONSERVATION CHALLENGES:

Vulnerable to loss or fragmentation of habitat due to development (i.e., urban), especially in consideration of alternative energy development and large-scale solar power plants.

NEEDS:

Research Needs: Research is needed to determine status and distribution, describe habitat relationships, and determine population viability. Analysis of habitat integrity and connectivity is also needed.

Monitoring and Existing Plans: This is a Clark County MSHCP Covered Species.

Approach: Investigate population distribution, status, and conservation risk. Develop conservation strategy as needed. Monitor responses to climate change-induced habitat transitions.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian.

western banded gecko *Coleonyx variegatus*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend unknown.

DISTRIBUTION: In southern NV, from below sea level in desert sinks to about 1,500 m (5,000 ft). Conrad and Bradley (2009) suggest that this species is extending its range from the Mojave Desert into the Great Basin.

GENERAL HABITAT AND LIFE HISTORY:

Creosote bush and sagebrush desert, pinyon-juniper belt, catclaw-cedar-grama grass association in the eastern part of range, chaparral areas in west (Stebbins 2003). In rocky areas and in barren dunes. They occur from from below sea level in desert sinks to about 1,500 m.

Opportunistic foragers on insects and other arthropods including beetles, termites, spiders, grasshoppers, sowbugs, and insect larvae (Zeiner et al 1988-90 [updated 2000]).

Under cover or underground when inactive. Take cover under rocks, rock caps, boards, fallen yucca stems, cow dung, or other litter, or may seek refuge in mammal burrows. This species is nocturnal due to its preference for lower body-temperatures and its high rates of evaporative water loss (Jones and Lovich 2009). It is most active just after dark, with activity declining gradually until ceasing at dawn (Zeiner et al 1988-90 [updated 2000]).

CONSERVATION CHALLENGES:

Vulnerable to transition and loss of habitat, potential localized pressure from commercial collection.

NEEDS:

Research Needs: Determine status and trend and response to climate change-induced habitat transitions.

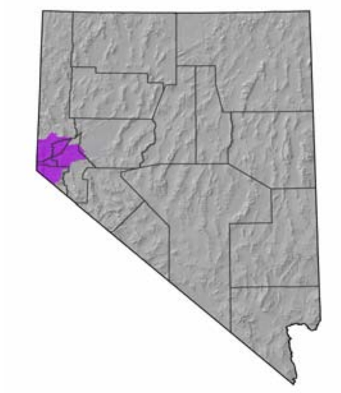
Monitoring and Existing Plans: This species is a Covered Species under the Clark County MSHCP.

Approach: Determine population status via responsive multi-species monitoring project, monitor trend, and adjust allowable harvest according to demonstrated need to maintain population numbers. Partner with Partners in Amphibian and Reptile Conservation and the Association of Fish and Wildlife Agencies' Amphibian and Reptile Subcommittee, Law Enforcement Committee, and Sustainable Use Committee to develop recommendations for collection regulations (Nanjappa and Conrad 2011).

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands and Chaparral, Sand Dunes and Badlands, Cliffs and Canyons.

western pond turtle *Actinemys marmorata*

WAP 2012 species because it has limited distribution and habitat availability.



Agency Status	
NV Natural Heritage	G3G4S3
USFWS	No Status
USFS-R5	Sensitive
CCVI	Presumed Stable

TREND: The trend for this species is unknown.

DISTRIBUTION: This species has limited range in western NV in Truckee and Carson Rivers and nearby ponds.

GENERAL HABITAT AND LIFE HISTORY:

This species is found in permanent and intermittent waters of rivers, creeks, small lakes and ponds, marshes, irrigation ditches, and reservoirs. It is sometimes found in brackish water. The western pond turtle often uses basking sites (e.g., logs, vegetation mats, rocks). It commonly basks on land, near or away from water (Rathbun et al. 2002). When disturbed, the western pond turtle seeks cover underwater. It nests on sandy banks near water or in fields or sunny spots up to a few hundred meters from water (Nussbaum et al. 1983, Storer 1930).

This species is a scavenger and opportunistic predator with preference for live prey. Adults are partially herbivorous and food items are mostly aquatic (Bury 1986). Diet often includes adult and larval insects, worms, crustaceans, carrion, and algae. Pond turtles in a northwestern study did not forage on land (Rathbun et al. 2002).

The western pond turtle is most active when water temperatures are above 15°C (59°F) (Bury and Germano 2008). It is active February through mid-November in northern part of range (Stebbins 2003). By switching to absorbing oxygen through the skin pond turtles hibernate underwater, often in the muddy bottom of a pool, but may be active during warm periods in winter (californiaherps.com). It is active diurnally and on warm nights. The age of first reproduction in females is about 7-9 years in the south and 10-14 years in the north (Bury 1979). It is subject to predation by various carnivores and introduced bullfrogs and fishes.

CONSERVATION CHALLENGES:

This species has limited distribution and habitat availability. Populations in Nevada are confined to the Truckee and Carson Rivers. The very isolated nature of the Nevada populations in relation to populations in the rest of its range raises the question of whether or not this species is native to Nevada - a question that has never been decisively answered. Elsewhere populations have declined due to habitat loss and degradation, disease, and introduced species, including the bullfrog

NEEDS:

Research Needs: Research is needed to determine current status, distribution, population viability, and subspecies status.

Monitoring and Existing Plans: This species is not currently monitored and does not occur within any other existing plans.

Approach: Develop a single-species investigation project to determine exact distribution, rough population estimate and trend, genetic diversity, origin, and metapopulation connectivity. Monitor response to climate change-induced habitat transitions, particularly changes in water temperature and flow. Determine relative conservation risk and develop conservation strategy with partners and stakeholders as necessary.

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs, Developed Landscapes.

western red-tailed skink *Plestiodon gilberti rubricaudatus*

WAP 2012 species because it requires mesic microhabitats in the Mojave desert that are vulnerable to drying due to climate change.

Agency Status	
NV Natural Heritage	G5T4QS2S3
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Habitat associations in NV appear to deviate from those described elsewhere (e.g., Stebbins 1985) in the species range. Specimens in NV have been encountered in sagebrush with widely scattered junipers, the blackbrush/sagebrush ecotone, and creosote bush; all have been encountered far from permanent water.

Eats insects and spiders.

CONSERVATION CHALLENGES:

Vulnerable to climate change-induced habitat transitions and loss.

NEEDS:

Research Needs: Refine species-habitat relationships; develop predictive model to inform adaptive management.

Monitoring and Existing Plans: Collaborative monitoring effort between NDOW, NV Biodiversity Initiative, and Clark County MSHCP; single species-focus monitoring. Covered Species under the Clark County MSHCP.

Approach: Focus on research needs; generate rough population estimates and trends via occupancy modeling. Develop conservation strategy as needed.

WAP HABITAT LINKS: Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Intermountain Riparian, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Cliffs and Canyons.

western threadsnake *Rena humilis*

WAP 2012 species because it requires mesic microhabitats within the Mojave Desert that are vulnerable to drying due to climate change.

Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: This species status and trend are unknown.

DISTRIBUTION: Mojave Desert of southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

This species habitats range from deserts and desert-grasslands to brush-covered mountain slopes, including rocky hillsides, canyon bottoms or washes near stream courses, riparian zones, areas near springs, and sometimes gardens and farmland (Werler and Dixon 2000, Stebbins 2003). This secretive, fossorial snake sometimes can be found under rocks, wood, or debris, among plant roots, or in crevices, often in loose damp soil.

The western blind snake eats small insects and their larvae and eggs (especially ants and termites), spiders, centipedes, and millipedes (Stebbins 2003). When searching for food, a western blind snake will hunt until it finds an ant pheromone trail and follow it back to the nest to consume the residents.

This snake appears on the surface at night but may be active underground at other times. Greatest seasonal activity occurs from April to August (Stebbins 1954). The western blind snake mates in the spring. Females tend to the eggs and may use communal nests.

CONSERVATION CHALLENGES:

Vulnerable to habitat transition and loss due to climate change, alternative energy development, and large-scale solar power plants.

NEEDS:

Research Needs: Determine status, trend, and distribution of the species.

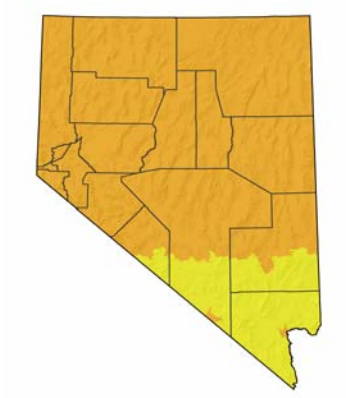
Monitoring and Existing Plans: This species is not currently monitored and does not occur within any other existing plans.

Approach: Investigate population distribution, status, and conservation risk. Develop conservation strategy as needed. Monitor responses to climate change-induced habitat transitions.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Lower Montane Woodlands and Chaparral, Cliffs and Canyons, Springs and Springbrooks, Agricultural Lands.

American Avocet — *Recurvirostra americana*

WAP 2012 species due to breeding stewardship responsibility and wetland habitat concerns, particularly in the context of climate change.



Agency Status	
NV Natural Heritage	G5S4B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The population size in Nevada is estimated to be 18,000 (expert, moderate). The trend is cyclic but stable.

DISTRIBUTION: Breeds in northeast to western NV; migrant throughout state.

GENERAL HABITAT AND LIFE HISTORY:

Lowland marshes, mudflats, ponds, alkaline lakes, and estuaries (AOU 1983). Usually nests on open flats or areas with scattered tufts of grass on islands or along lakes (especially alkaline) and marshes. Readily nests on artificial islands (such as those created for waterfowl) in impoundments (Giroux 1985).

Eats a variety of aquatic insects and their larvae, crustaceans, and seeds of aquatic plants, obtained mainly from soft muddy bottom or water surface. May extend head, or dive, under surface of water while feeding.

CONSERVATION CHALLENGES:

Vulnerable to loss or degradation of ephemeral and permanent wetlands due to water diversion, development, and drought. Likely to be impacted by changing precipitation patterns associated with climate change.

NEEDS:

Research Needs: Improve breeding pair estimates on major wetlands. Improve monitoring coverage of ephemeral wetlands and playas from the breeding season through the post-breeding and fall migration periods (Warnock et al. 1998).

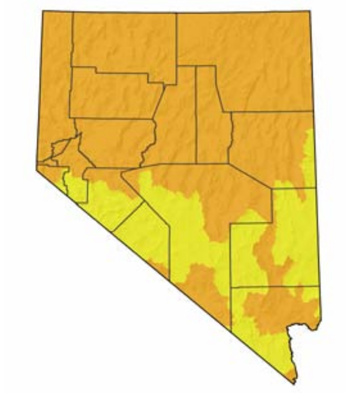
Monitoring and Existing Plans: Monitored through the Nevada Aquatic Bird Count and covered in the U.S. Shorebird Conservation Plan, Intermountain West Shorebird Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Continue to monitor via the Nevada Aquatic Bird Count. Focus conservation actions for maximum breeding success in peak water years. Promote seasonal fresh-water runoff into ephemeral wetlands and playas, as well as into sparsely-vegetated permanent marshes, sufficient to create mud flats and maintain a shallow-water shoreline for the longest possible period.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

American Bittern *Botaurus lentiginosus*

WAP 2012 species because of perceived population declines in the U.S. and western region (with some potential improvement in the last decade), it is moderately vulnerable to climate change, and its preferred habitat is sensitive and vulnerable to degradation.



Agency Status	
NV Natural Heritage	G4S3B
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Population size and trend are unknown in Nevada; possible declines across its range.

DISTRIBUTION: Breeds primarily across the northern portion of Nevada with wintering birds occurring in the south.

GENERAL HABITAT AND LIFE HISTORY:

Habitat is primarily large freshwater and (less often) brackish marshes, including lake and pond edges where cattails, sedges, or bulrushes are plentiful and marshes where there are patches of open water and aquatic-bed vegetation. Occurs also in other areas with dense herbaceous cover, such as shrubby marshes, bogs, wet meadows, and, rarely, hayfields (Brewer et al. 1991). Readily uses wetlands created by impoundments. Wetlands of 2.5 ha or more may support nesting; smaller wetlands may serve as alternate foraging sites (Gibbs and Melvin 1992).

Eats mainly fishes, crayfishes, amphibians, mice and shrews, insects, and other animals (Palmer 1962).

CONSERVATION CHALLENGES:

Vulnerable to loss and degradation of wetlands due to water diversion, development, drought, and heavy metal contamination.

NEEDS:

Research Needs: Baseline population status and trend and sensitivities to water quality are needed.

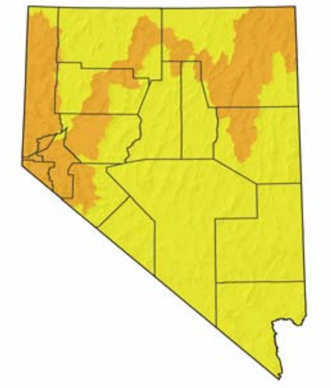
Monitoring and Existing Plans: Not currently monitored; may be captured in the Aquatic Bird Survey program. Included in the Intermountain West Waterbird Conservation Plan.

Approach: Protect and maintain wetland habitats, particularly large (greater than 10 ha), shallow wetlands with dense growths of robust emergents as this species entire life cycle is dependent on this habitat type. Consider purchases of land and water rights or easements to protect vital wetland habitat.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Wet Meadow.

American White Pelican *Pelecanus erythrorhynchos*

WAP 2012 species because it is moderately vulnerable to climate change and high Nevada stewardship responsibility for breeding populations at Anaho Island, which, in some years, is the largest nesting colony in the west.



Agency Status	
NV Natural Heritage	G4S2B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The average breeding population estimate is 8,600 (USFWS, high). The population trend is cyclic, but assumed stable.

DISTRIBUTION: Breeding bird in northwestern and rarely in northeastern NV, migrant throughout the state.

GENERAL HABITAT AND LIFE HISTORY:

Habitat is primarily rivers, lakes, reservoirs, estuaries, and marshes. Rests and nests on islands and peninsulas in brackish or freshwater lakes, isolated from mammalian predators. In NV, Anaho Island is the site of one of the most important nesting colonies in the West. Nesting documented on Franklin Lake, northeast Nevada in wet years.

This species is gregarious. It feeds mainly on fishes of little commercial value (e.g., carp, chub, suckers) (Terres 1980), and locally also feeds on trout, centrarchids, or crayfishes. Often forages in shallow water. Sometimes fishes cooperatively, forming a semicircle and herding fishes. In some areas, forages at night as well as diurnally (McMahon and Evans 1992).

CONSERVATION CHALLENGES:

Anaho Island NWR is intensively managed for this species, but issues surrounding water delivery (quantity, quality, timing) to foraging sites as well as the long-term maintenance of water levels in Pyramid Lake can be problematic. Breeding colonies have low tolerance to disturbance and are highly susceptible to predation; susceptible to pesticide contamination; also vulnerable to the loss of breeding and feeding areas.

NEEDS:

Research Needs: Connectivity between major western nesting colonies, regional dispersal (breeding and post-breeding), and the relationship of game vs. nongame fish predation to the relative availability of each.

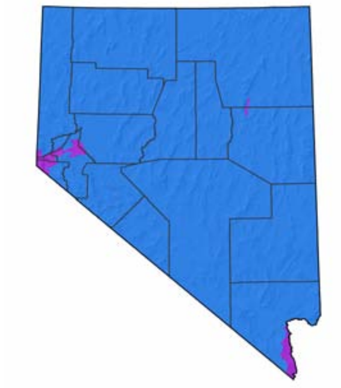
Monitoring and Existing Plans: The USFWS monitors the Anaho Island population. Also, breeding populations are monitored under the Nevada Aquatic Bird Count (see GBBO 2005a). Covered under the Intermountain West Waterbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain water levels and productive nongame fisheries where birds nest and forage. Limit or restrict access to breeding colonies especially during courtship and early incubation.

WAP HABITAT LINKS: Lakes and Reservoirs.

Bald Eagle (Contiguous US Pop) *Haliaeetus leucocephalus*

WAP 2012 species due to delisting recovery monitoring responsibility and Bald and Golden Eagle Protection Act concerns.



Agency Status	
NV Natural Heritage	G5S1B,S3N
USFWS	No Status
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Endangered Birds NAC 503.050.2
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The breeding population in Nevada consists of 3-5 nesting pairs; winter population estimate is 120 (NDOW, high). Trend is stable or increasing.

DISTRIBUTION: Winters throughout the state. There are a few scattered breeding occurrences in northern NV.

GENERAL HABITAT AND LIFE HISTORY:

Often roosts communally, especially in winter. Winter home ranges can be very large, especially for non-breeding birds. Usually nests in tall trees or on cliffs near bodies of water that provide a food base. Nest trees include pines, spruce, firs, and cottonwoods. Nests located on cliffs and rock pinnacles have been reported historically in NV. The same nest may be used year after year, or may alternate between two nest sites in successive years. In NV, preferentially roosts in thick cottonwood groves, but sometimes in conifers or other sheltered sites in some areas; communal roost sites in Nevada have harbored as many as 65 birds in a night and are preferred for their warmer microclimates. Winter distribution is influenced by waterfowl concentrations or wetland sites with abundant dead fish (Griffin et al. 1982). Recent increase in winter numbers in Carson Valley associated with calving; eagles eat the nutrient rich placenta.

Feeds opportunistically on fishes, injured waterfowl, various mammals, and carrion (Terres 1980). Hunts live prey, scavenges, and pirates food from other birds.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss, disturbance by humans, biocide contamination, decreasing food supply, illegal shooting, and incidental poisoning from anti-predator baits (Evans 1982, Green 1985, Herkert 1992). Management of nest territories in areas of high human activity (Beebe 1974, Fraser 1985).

NEEDS:

Research Needs: Identify impact of mercury on NV populations (contaminant analysis).

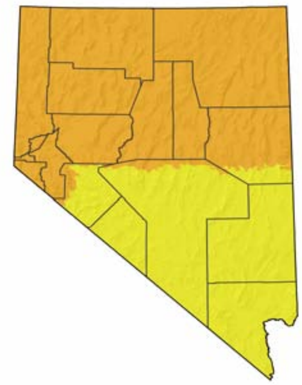
Monitoring and Existing Plans: Winter populations monitored by the NV Wintering Bald Eagle Count. Nest success monitoring at active sites by NDOW, USFWS, and LTBMU. Covered in the Pacific States Bald Eagle Recovery Plan, LTBMU Forest Plan, and the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Monitor and develop management plans for active nest territories. Participate in tri-annual mid-winter bald eagle survey. Conduct a thorough inventory of winter roost sites in coordination with the midwinter bald eagle survey (Steenhof et al. 2008). Partner with public land managers and private land owners to maintain nesting success and wintering concentration conservation.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Intermountain Riparian.

Bank Swallow *Riparia riparia*

WAP 2012 species due to continental population declines, continued concern in California, and it is moderately vulnerable to climate change.



Agency Status	
NV Natural Heritage	G5S3B
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: The Nevada population estimate is 130,000 (PIF, low). The trend in Nevada is inconclusive, but BBS data indicate a significant survey-wide decline for 1966-2007.

DISTRIBUTION: Occurs primarily in northern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Open and partly open situations, frequently near flowing water (AOU 1983). Nests in steep sand, dirt, or gravel banks, in a burrow dug near the top of the bank, along the edge of inland water or along the coast, or in gravel pits, road embankments, etc. Tends to return to same nesting area in successive years, though may move several kilometers away, especially if nesting was unsuccessful the previous year; yearlings often return to the natal area or nearby (Turner and Rose 1989).

Feeds primarily on flying insects (e.g., beetles, mosquitoes, winged ants, flies, moths). Catches insects in the air over fields, wetlands, water, etc. If necessary, may forage up to several kilometers from nesting area, but usually closer.

The GBBO (2011) analysis of bird population responses to projected effects of climate change could not attach Bank Swallow to any measurable parameter of riparian habitats.

CONSERVATION CHALLENGES:

Vulnerable to desiccation of streamflow as a result of human activities such as damming and water diversion and loss of steep friable cut banks to flood and erosion control projects. However, suitable habitat, such as sand and gravel pits, has also been created by human activities (see Garrison 1999).

NEEDS:

Research Needs: Improve population status and trend; inventory colony sites.

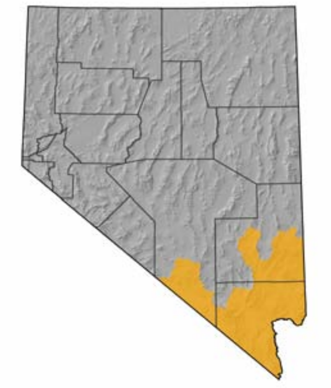
Monitoring and Existing Plans: Species may be captured in the NBC program.

Approach: Protect suitable nesting habitat by maintaining appropriate streamflow and bank configuration. Provide anthropogenic nesting habitat where appropriate. Maintain quality foraging areas particularly open meadows generally within 1 km of the colony.

WAP HABITAT LINKS: Intermountain Riparian, Lakes and Reservoirs, Wet Meadow.

Bell's Vireo *Vireo bellii*

WAP 2012 species because it is an Audubon watchlist species and IUCN near-threatened species.



Agency Status	
NV Natural Heritage	G5S2B
USFWS	No Status
Aud	Red List
CCVI	Presumed Stable

TREND: The population estimate for this species is 1,000 (NBC, moderate). Trends are stable to increasing in the U.S., West, and Mojave.

DISTRIBUTION: Southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Occupies dense, low, shrubby vegetation, generally early successional stages in riparian areas, brushy fields, young second-growth forest or woodland, scrub oak, and mesquite brushlands, often near water in arid regions. May nest in any successional stage with dense understory vegetation. Habitat generalist in riparian scrubland dominated by the introduced shrub saltcedar along the Colorado River in Grand Canyon, AZ (Brown and Trosset 1989); specialist in native seep willow and mesquite habitats of the Lower Colorado River Valley, AZ, where saltcedar is rarely used (Rosenberg et al. 1991). Largely absent in intensively cultivated areas, forests, pure grasslands, open deserts, and elevations >1,300 m (4,265 ft). Nests suspended from small, lateral or terminal forks of low, pendant branches (or even horizontal parallel stems) in dense bushes, small trees, and occasionally herbaceous vegetation (Nolan 1960, Barlow 1962). Most nests located 0.5 to 1.5 m (1.6-4.9 ft) above ground, ranging from 0.2 to 8.0 m (0.7-26 ft).

Diet is 99.3% insects and spiders, 0.7% vegetable matter (fruit); no other vireo consumes as many large insects (Chapin 1925).

The GBBO (2011) analysis of bird population responses to projected effects of climate change predicted little change for Bell's Vireo until saltcedar (Tamarix spp.) dominance of riparian tree composition exceeds 90%.

CONSERVATION CHALLENGES:

Land use patterns, particularly along streams and rivers (riparian habitat), strongly influence abundance in breeding range. In the southwestern U.S., riparian habitat modifications including agriculture, urbanization, firewood cutting, grazing, flood control projects, and reservoir construction have reduced habitat for this species. Large water releases from dams and reservoirs in Apr, May, and Jun can inundate low-lying vireo nests in downstream areas, resulting in high nest loss and egg/nestling mortality (Brown and Johnson 1985). In contrast, a vireo range expansion and associated increase in abundance along the Colorado River through Grand Canyon, AZ, has resulted from a local increase in riparian habitat caused by the Glen Canyon Dam (Brown et al. 1983). Modifications that promote habitat patchiness apparently increase rates of cowbird parasitism and act to segregate remaining breeding vireos into disjunct subpopulations that are more susceptible to local extinction (Franzreb 1989). Overgrazing suppresses shrub growth and reduces available nest sites and vireo density (by 50% in Oklahoma; Overmire 1963).

NEEDS:

Research Needs: Detailed response of this species to desertification of riparian habitats is needed.

Monitoring and Existing Plans: Captured through the NV All Bird Count program. Covered in the Partners in Flight North American Landbird Conservation Plan, Nevada Comprehensive Bird Conservation Plan, Clark County MSHCP Covered Species, and the Lower Colorado River MSCP Covered Species.

Approach: Conserve and protect riparian habitats of the southwest. Preserve mesquite bosques through private landowner consultation and responsive development planning.

WAP HABITAT LINKS: Warm Desert Riparian.

Bendire's Thrasher *Toxostoma bendirei*

WAP 2012 species due to declining rangewide trends and concerns over the stability of its Mojave shrub habitat, particularly in the context of climate change.

Agency Status	
NV Natural Heritage	G4G5S1
USFWS	No Status
BLM-NV	Sensitive
BLM-CA	Special Status Species
PIF	Priority Bird Species
IUCN	Vulnerable
Aud	Red List
CCVI	Presumed Stable

TREND: Although the NV trend is unknown, continentally, they are seriously declining indicating a concern may exist in NV as well.

DISTRIBUTION: Range restricted to Joshua tree transitional zones in the Mojave Desert.

GENERAL HABITAT AND LIFE HISTORY:

Uses a variety of desert habitats with fairly large shrubs or cacti and open ground, or open woodland with scattered shrubs and trees, 0-550 m elevation. Avoids uninterrupted brushy cover and continuous grassland (Phillips et al. 1964). In north and at higher elevations, found in sagebrush and scattered junipers. At lower elevations, occurs in desert grassland and shrubland with spiny shrubs or cacti, such as cholla, Joshua tree, mesquite, catclaw, desert-thorn or agave (AOU 1983, England and Laudenslayer 1993). Nests usually about 1-1.5 m (3-5 ft) above ground typically in mesquite, cholla, juniper, Joshua tree, and other yucca species, but occasionally also in catclaw, willow, and saltbush (England and Laudenslayer 1993).

Feeds on insects and other arthropods, especially caterpillars, beetles, grasshoppers, ants, termites. Forages primarily on the ground, but will also pluck fruit and glean vegetation for insects (Terres 1980, England and Laudenslayer 1993). Primarily gleans and probes; also digs with bill in leaf litter and sandy soil although does not dig as much as other thrashers; possibly avoids rocky soils and slopes that preclude digging (England and Laudenslayer 1993, USDA Forest Service 1994).

CONSERVATION CHALLENGES:

Vulnerable to fire and urban, suburban, agricultural, and energy development. This species has low population numbers (probably not historically very numerous) and is more vulnerable to habitat degradation.

NEEDS:

Research Needs: Develop improved methods for monitoring species; collect additional monitoring data to better determine habitat use parameters. Information is needed on habitat preferences, and response to habitat changes to better understand the potential for maintaining or restoring populations. Information is needed on incubation and nestling periods; predators and competitors; brood parasitism rates and behavioral response; diet and foraging strategies; migration; winter range and ecology; habitat preferences; landscape relationships; and metapopulation structure and dynamics.

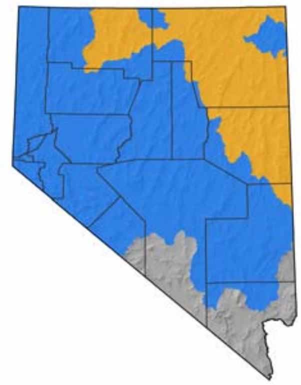
Monitoring and Existing Plans: The NV All Bird Count program captures this species. Species is covered in the Clark County MSHCP, Partners in Flight North American Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Determine population status, distribution, and trend in NV. Determine connectivity of NV populations to surrounding populations. Identify factors leading to population declines. Promote additional land protections for critical habitat.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub.

Black Rosy-Finch *Leucosticte atrata*

WAP 2012 species because it is highly vulnerable to climate change, Nevada stewardship responsibility, its restricted range, and concerns over its high-elevation habitat with respect to climate change.



Agency Status	
NV Natural Heritage	G4S3
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Highly Vulnerable

TREND: Status and trend unknown.

DISTRIBUTION: Winters through central and northern NV. Breeds in Ruby Mountains, Snake Range (GBBO 2005), Santa Rosa Mountains, Jarbidge Mountains, Independence Range, East Humboldt Range, Schell Creek, Toiyabe, Toquima and Pilot Mountains.

GENERAL HABITAT AND LIFE HISTORY:

Barren, rocky or grassy areas and cliffs among glaciers or beyond timberline; in migration and winter also in open situations, fields, cultivated lands, brushy areas, and around human habitation (AOU 1983). May roost in mine shafts or similar protected site. Nests usually in rock crevices or holes in cliffs above snow fields. May nest in old abandoned buildings.

Forages on the ground for seeds. In the spring gleans wind-transported insects from the snow. Later in the season may glean insects from vegetation or may chase flying insects and catch them in the air.

CONSERVATION CHALLENGES:

A regional priority species; concern exists regarding its wintering habitat stability. Vulnerable to permanent closures of abandoned mines harboring communal winter night roosts.

NEEDS:

Research Needs: Research should be conducted to determine population and breeding status, and distribution in NV.

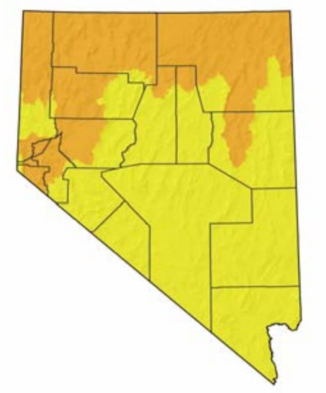
Monitoring and Existing Plans: Winter radio telemetry work was conducted by NDOW in 2005. Covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Survey all potential winter night roost habitats within 8 km of known winter foraging habitats (Bradley 2005). Develop roost conservation strategies, including wildlife-friendly mine closure plans in cooperation with land management agencies and Nevada Division of Minerals as appropriate.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Grasslands and Meadows, Cliffs and Canyons, Alpine and Tundra, Caves and Mines.

Black Tern *Chlidonias niger*

WAP 2012 species due to declining continental trends.



Agency Status	
NV Natural Heritage	G4S2S3B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 700 (expert, moderate). Range-wide trend is declining, although Shuford (1998) conclude interior West populations are stable. Black Tern's declining trends in Nevada are mostly attributable to the decline and recent loss of the Ruby Lake NWR colony (GBBO 2010).

DISTRIBUTION: Migrant throughout NV. Historical and current breeding sites include Ruby Lake NWR, Lahontan Valley, Humboldt Sink, Mason Valley WMA, the Boyd Humboldt Valley IBA, Quinn River, and Pahranagat NWR.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in marshes, rivers, lake shores, impoundments, or in wet meadows, typically in sites with mixture of emergent vegetation and open water. Cattails, bulrushes, burreed, or phragmites commonly are present in nesting areas (Bent 1921, Cuthbert 1954, Goodwin 1960, Bailey 1977, Firstencel 1987, Novak 1990). Nested in greatest numbers where emergent vegetation and open water are in an approximately 50:50 ratio (Weller and Spatcher 1965). Has been described as a semi-colonial nesting species (Cuthbert 1954, Bergman et al. 1970).

On the breeding grounds the black tern is primarily insectivorous, although small crustaceans, spiders and small fishes are also regular food items (McAtee and Beal 1912, Bent 1921). The diet may vary depending on habitat and food availability.

Nest losses have been attributed to wind and wave action, egg inviability, predation, muskrat activity, and intraspecific interactions (Bergman et al. 1970, Bailey 1977, Dunn 1979, Firstencel 1987).

CONSERVATION CHALLENGES:

Vulnerable to loss or degradation of freshwater marsh habitat due to water diversions, declines in water quality, invasion of exotic plants, drought, and development. Changes in water level during incubation may destroy nests. Vulnerable to heavy metal contamination and pesticide use and residual buildup.

NEEDS:

Research Needs: Causes of ongoing declines are not well understood and require more detailed research and monitoring in order to determine appropriate conservation actions. Enhanced monitoring and surveying efforts are needed to better determine breeding numbers and distributions at known or potential breeding sites across the state. This could determine whether current declines, largely attributable to the decline and recent loss of the Ruby Lake NWR breeding colony, are systemic across Nevada. Additional research and monitoring is needed to document the ongoing status of the Ruby Lake NWR to determine the causes for the cessation of breeding activity in 2006. Additionally, research should include evaluating the effectiveness of artificial nest platforms for increasing nesting success or population densities. Determine nest site fidelity of adults and site fidelity of young. Determine the effects of contaminants on nesting success, chick development, and juvenile and adult survival. Assess the effects of human disturbance and develop or improve the capability to regulate water levels and manage habitat for the benefit of breeding terns at key wetlands.

Monitoring and Existing Plans: Captured in the Nevada Aquatic Bird Count. Covered in the Intermountain West Waterbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Develop beneficial water management strategies through cooperative planning and agreements for colony sites. Historical sites should be identified and restored to colony site potential. Enforce wetlands and water quality regulations; encourage greater public recognition of wetland values.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Desert Playas and Ephemeral Pools, Wet Meadow.

Black-chinned Sparrow *Spizella atrogularis*

WAP 2012 species due to declining trends rangewide and its preferred habitat is sensitive and vulnerable to degradation, particularly in the context of climate change.

Agency Status	
NV Natural Heritage	G5S3B
USFWS	No Status
PIF	Priority Bird Species
Aud	Red List
CCVI	Presumed Stable

TREND: The population estimate in NV is 8,400 (NBC, moderate); trend is inconclusive; steep and significant declines for the Western BBS Region.

DISTRIBUTION: Mojave Desert region of southern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in chaparral, sagebrush, and arid scrub; on gentle hillsides to steep, rocky slopes, or in brushy canyons; sea level to nearly 2,700 m (8,860ft) (AOU 1998, Rising 1996, Tenney 1997). In montane chaparral, associated with chamise, ceanothus, and scrub oak-dominated habitats. Nests in loose local colonies (Rising 1996, Terres 1980).

Feeds on insects and small seeds. Forages in brush and on ground. Flies under and over brush in search of food.

Generally moves downslope after breeding or south into desert grassland scrub, where grass and forb seeds are an important winter food source (Tenney, pers. comm.). May forage beneath shrub canopy or in adjacent grassy areas (Tenney 1997). Based on the TNC (2011) model, Black-chinned Sparrows in Nevada may be affected by the decline in late-successional, higher-elevation (mesic) blackbrush, which is partially offset by minor gains in other cover types, resulting in a projected population decrease of 19% in 50 years.

CONSERVATION CHALLENGES:

Vulnerable to local loss of breeding habitat due to mining, off-road vehicles, and overgazing (Tenney 1997). Also, alteration of fire regimes that are increasing the density of pinyon-juniper woodlands (GBBO 2010).

NEEDS:

Research Needs: Studies are needed to better pinpoint key habitat and landscape features important to Black-chinned Sparrows and to identify and quantify conservation threats.

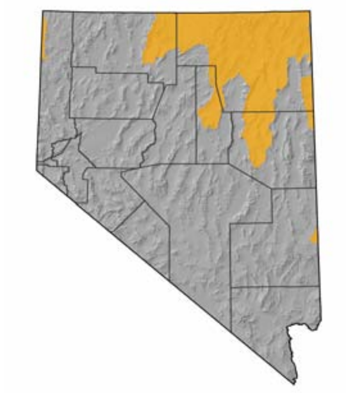
Monitoring and Existing Plans: Species is captured by the NV All Bird Count and covered under the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Monitor through the NV Bird Count; develop conservation and restoration strategies for montane shrub communities including thinning overgown pinyon-juniper woodlands near their shrubland interface which may be beneficial to Black-chinned sparrows.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral.

Bobolink *Dolichonyx oryzivorus*

WAP 2012 species due to declining continental trends, its restricted range in Nevada, and concerns over riparian habitat vulnerability.



Agency Status	
NV Natural Heritage	G5S3B
USFWS	No Status
CCVI	Presumed Stable

TREND: The NV population size and trend are unknown; significant decline in North America and Great Basin (BBS).

DISTRIBUTION: Breeds in northeastern Nevada, associated with the upper Humboldt, Little Humboldt, and Owyhee and Bruneau River drainages.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in tall grass areas, flooded meadows, prairie, deep cultivated grains, and hayfields (AOU 1998). Nests on ground in small hollow in area of concealing herbaceous vegetation. Tends to return to breed in same area in successive years, especially if that site has had good Bobolink productivity (Bollinger and Gavin 1989). Prefers habitat with moderate to tall vegetation, moderate to dense vegetation, and moderately deep litter (Tester and Marshall 1961, Bent 1958, Harrison 1974, Bollinger 1995), and without the presence of woody vegetation (Sample 1989, Bollinger and Gavin 1992). Found in native and tame grasslands, haylands, lightly to moderately grazed pastures, no-till cropland, small-grain fields, oldfields, wet meadows, and planted cover (NatureServe 2011, and citations therein).

Eats insects, seeds, grain (Terres 1980); mainly seeds (Stiles and Skutch 1989).

CONSERVATION CHALLENGES:

Decline attributed to decrease in hayfield area, earlier and more frequent hay-cropping. Unsustainable grazing practices that reduce grass cover and increase shrubs would negatively impact this species.

NEEDS:

Research Needs: Research on the relationship between grazing regimes and habitat maintenance and population productivity needs to be conducted in Nevada.

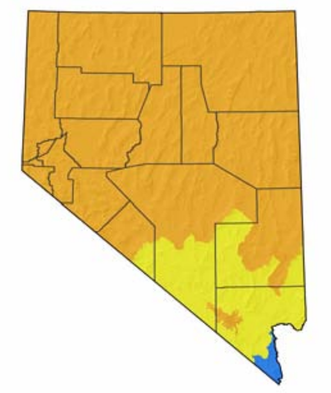
Monitoring and Existing Plans: Nevada All Bird Count captures this species, though its limited distribution in Nevada may warrant specific area searches.

Approach: Provide large areas of suitable habitat (native and tame grasslands of moderate height and density, with adequate litter), control succession, but defer grazing and hay harvest until after the breeding season, approximately early May to mid-July (Bollinger 1991). Treatments can be done in early spring (several weeks prior to the arrival of adults on the breeding grounds) or in the fall after the breeding season (Martin and Gavin 1995). Appears to respond positively to moderate grazing or short-duration grazing schedule, though there is no research on this topic specifically in Nevada.

WAP HABITAT LINKS: Agricultural Lands, Grasslands and Meadows, Wet Meadow, Marshes, Intermountain Riparian.

Brewer's Sparrow *Spizella breweri*

WAP 2012 species because it is moderately vulnerable to climate change and due to the possibility of large-scale sagebrush habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5S4B
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Birds NAC 503.050.3
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Moderately Vulnerable

TREND: The NV population size estimate is 7.4 million (NBC, moderate); significant NV and range-wide decline (BBS).

DISTRIBUTION: Breeds throughout northern NV, year-round population in southwest NV, winter resident in extreme southeast NV.

GENERAL HABITAT AND LIFE HISTORY:

Strongly associated with sagebrush, and high sagebrush vigor (Knopf et al. 1990), over most of its range, in areas with scattered shrubs and short grass. Can also be found to lesser extent in mountain mahogany, rabbit brush, bunchgrass grasslands with shrubs, bitterbrush, ceanothus, manzanita and large openings in pinyon-juniper (Knopf et al. 1990; Rising 1996; Sedgwick 1987; USDA Forest Service 1994). Positively correlated with shrub cover, above-average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness); negatively correlated with grass cover, spiny hopsage, and budsage (Larson and Bock 1984; Rotenberry and Wiens 1980; Wiens 1985; Wiens and Rotenberry 1981). Prefer areas dominated by shrubs rather than grass. Prefers sites with high shrub cover and large patch size, but thresholds for these values not quantified (Knick and Rotenberry 1995). Nests low in sagebrush (preferred), other shrub, or cactus, from a few centimeters to about 1 meter from ground. Also place nests higher in taller sagebrush (Rich 1980).

In spring and summer consumes many insects. In fall and winter feeds on seeds. Forages mainly on the ground. Drinks free water when available and will bathe in standing water; but adapted to arid environments and can physiologically adjust to water deprivation, obtaining water from foods (Dawson et al. 1979; Rotenberry et al. 1999). May be food-limited in winter, as winter density is positively correlated with summer rainfall, and rainfall increases abundance of seeds available to wintering birds (Dunning and Brown 1982).

The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates Brewer's Sparrow population change is most affected by projected losses of big sagebrush/mid-open, mountain sagebrush/mid-closed, and mountain sagebrush/depleted covers, and shows the largest projected gains in sagebrush/annual grass and salt desert/shrub/annual covers, for a projected total of a 14% reduction in statewide population size over 50 years.

CONSERVATION CHALLENGES:

Vulnerable to loss, degradation, or possibly fragmentation of high-quality sagebrush and montane sagebrush shrubland due to fire, invasive plants, expansion of pinyon-juniper woodland into sagebrush, unsustainable livestock grazing, and excessive off-highway vehicle use.

NEEDS:

Research Needs: Determine extent of breeding in the Mojave habitat type, as well as the salt desert scrub type in the Great Basin. Determine the possibility of multiple breeding seasons (one in each major habitat type). Knowledge of specific use of uncharacteristic sagebrush classes and responses to cheatgrass invasion, pinyon-juniper encroachment, or conversion to rabbitbrush. More research needed on response to prescribed burn patterns. Understanding of minimum patch sizes, fragmentation effects, spatial juxtaposition of habitat patches, and other aspects of landscape ecology are needed. Study of extent of brood parasitism and impact of predation in relation to human alterations of habitat is needed. Further study of direct and indirect impacts of herbicides and pesticides typically used in sagebrush shrub-steppe rangelands is needed. Research life history and ecology during migration and wintering.

WAP HABITAT LINKS: Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Intermountain Cold Desert Scrub, Lower Montane Chaparral.

Monitoring and Existing Plans: Monitored through the NV All Bird Count program and covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain native sagebrush habitats with high shrub vigor, horizontal shrub patchiness, and an open understory of native bunchgrasses and forbs. Design Brewer's Sparrow population objectives into sagebrush restoration projects. Monitor results and track population changes. Develop a fire management strategy that ensures that high-quality sagebrush habitat receives priority fire suppression efforts in the immediate future. Additionally, develop fire management strategies that balance the need for short-term habitat protection with long-term habitat viability.

WAP HABITAT LINKS: Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Intermountain Cold Desert Scrub, Lower Montane Chaparral.

California Spotted Owl — *Strix occidentalis occidentalis*

WAP 2012 species because it is moderately vulnerable to climate change, there are concerns over the vulnerability of its preferred habitat (i.e., old-growth forest), and it is a USFS management species.

Agency Status	
NV Natural Heritage	G3T3S1N
USFWS	No Status
BLM-CA	Special Status Species
CCVI	Moderately Vulnerable

TREND: Population is estimated at 1-2 pairs in the Carson Range; nest activity is sporadic.

DISTRIBUTION: Known only in the Carson Range.

GENERAL HABITAT AND LIFE HISTORY:

Typical habitat is dense, multi-layered evergreen forest that includes a diversity of tree species, large trees (some greater than 83 cm DBH), some trees with evidence of decadence, and open areas under the canopy; most often on lower, north-facing slopes of canyons, usually within 0.3 km of water (Gould 1977, Bias and Gutiérrez. 1992). Commonly inhabited plant associations include: mixed conifer forest, usually dominated by ponderosa pine (southern Sierra Nevada); ponderosa pine, Douglas-fir, and/or white fir (northern Sierra Nevada) (Gould 1977). In the central Sierra Nevada, 97 percent of the habitat patches in which owls roosted were characterized by the presence of residual trees (greater than 100 cm dbh); owl roost and nest sites were also characterized by residual trees and high structural diversity (Moen and Gutiérrez 1997). Nests are on broken tree tops, cliff ledges, in natural tree cavities, or in tree on stick platforms, often the abandoned nest of hawk or mammal; sometimes in caves. This owl exhibits a high level of nest site fidelity.

Small mammals, particularly nocturnal arboreal or semi-arboreal species, predominate in diet; mostly Glaucomys, Neotoma, and Sciurus. Breeders take larger rodent prey than do nonbreeders (Thrailkill and Bias 1989). Generally hunts from perch at dusk and at night. May cache prey.

Adults may migrate downslope in fall, return to higher elevation in spring; fall (mid-October to mid-November) movements averaged 31 km (19 miles) with a change in elevation averaging 754 m (2,473 ft) in the Sierra Nevada, CA (Dawson et al. 1987, Laymon 1989).

CONSERVATION CHALLENGES:

Potentially vulnerable to landscape-level habitat conversion (e.g., catastrophic wildfire) or stand alteration of critical habitat for fire management purposes.

NEEDS:

Research Needs: Study juvenile dispersal and season movements to determine conservation needs, and conduct studies to determine conservation needs of primary prey species.

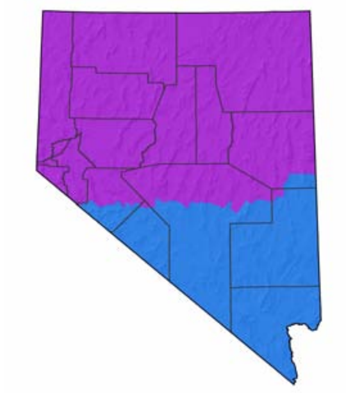
Monitoring and Existing Plans: Multi-agency nest territory monitoring. Covered in LTBMU Forest Plan, Humboldt-Toiyabe Forest Plan, Sierra Nevada Forest Plan Amendment, Partners in Flight North American Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Conduct annual monitoring of occupied territories to assure population is maintained. Expand surveys to include atypical habitat. Protect large tracts of old growth forest or younger forest of similar vegetative structure.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands.

Canvasback *Aythya valisineria*

WAP 2012 species due to both regional and continental historic population declines.



Agency Status	
NV Natural Heritage	G5S3S4
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The average NV breeding population is 2,700; the winter population estimate is 4,600 (NDOW, moderate). Trend stabilizing or rebounding after decline from 1955-1988.

DISTRIBUTION: Year-round in northwestern, breeding through central and northern, migrant elsewhere in NV.

GENERAL HABITAT AND LIFE HISTORY:

Habitat includes marshes, ponds, lakes, rivers and bays. Winters on deep, freshwater lakes and rivers (AOU 1983). Nests over water on matted-down emergent vegetation in freshwater marshes, including those bordering lakes, ponds, or rivers. Sometimes nests on old muskrat house or on dry ground.

Feeds on aquatic plants; pondweeds, wild celery, water lilies, seeds of grasses, wild rice, bulrush; rhizomes, and tubers. Seeds figure prominently in winter diet. Also some animal food; mollusks, aquatic insects, small fishes, etc. Feeds by diving from surface of water.

CONSERVATION CHALLENGES:

Vulnerable to loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development (Mowbray, 2002). May abandon breeding efforts during years of drought (Mowbray, 2002), or suffer nest failure in high water years (Kruse et al., 2003a).

NEEDS:

Research Needs: Responses to climate-induced changes to marsh habitats is needed.

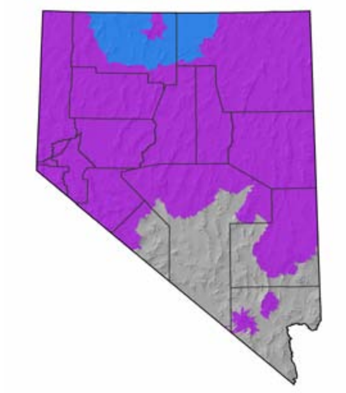
Monitoring and Existing Plans: Monitored through the NV Aquatic Bird Count, surveys conducted by refuge biologists, NDOW aerial surveys, and NDOW annual waterfowl breeding population (BPOP) surveys. Covered in the North American Waterfowl Management Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Continue to monitor via NDOW aerial waterfowl survey. Regulate harvest as necessary through Pacific Flyway Council. In breeding marshes, maintain a consistent water level during the nesting period (1 May-15 July); open water migration and wintering habitat should be managed to maintain the presence of submerged aquatic plants at depths up to 5 m [16 ft]. Pursue through partnerships, including the Intermountain West Joint Venture, improving, creating, restoring, and maintaining suitable habitat.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

Cassin's Finch — *Carpodacus cassinii*

WAP 2012 species due to stewardship responsibility based on significant declining trends continentally, in the U.S., Canada, the West, and in the Sierra Nevadas.



Agency Status	
NV Natural Heritage	G5S5
USFWS	No Status
IUCN	Near Threatened
CCVI	Presumed Stable

TREND: The NV population estimate is 130,000 (PIF, moderate); increasing significantly in Nevada (BBS).

DISTRIBUTION: NV-wide, year-round, but absent from the Mojave Desert region.

GENERAL HABITAT AND LIFE HISTORY:

Habitat consists of open coniferous forest; in migration and winter also in deciduous woodland, second growth, scrub, brushy areas, partly open situations with scattered trees (National Geographic Society 1983), and sometimes suburbs near mountains. Usually nests in conifer, 3-25 m above ground, on outer end of limb; may sometimes nest in deciduous tree or in shrub. May return to same nesting area in successive years, though this may be unusual (Mewaldt and King 1985).

Eats seeds and buds, insects, and berries. Forages high in trees or on the ground.

Usually seen in flocks, except during nesting season. Often seen in association with crossbills and evening grosbeaks. Male defends zone around female during breeding period; female more attached to a particular site than is male. The GBBO (2011) analysis of bird population responses to projected effects of climate change, as an appendix in this report, indicates overall populations of Cassin's Finch are projected to remain stable over the next 50 years. Decreases based on habitat cover change are expected in some habitat types, such as pinyon-juniper/early, but these are projected to be offset by increases from other habitat types, such as pinyon-juniper/late. The highest estimated densities currently occur in mixed conifer/dry pine, subalpine pine, and mountain mahogany.

CONSERVATION CHALLENGES:

Regional priority species; local population declines.

NEEDS:

Research Needs: Improved population status and trend is needed. Response to habitat transitions to uncharacteristic classes and loss of aspen and conifer habitats to climate change is needed.

Monitoring and Existing Plans: NV All Bird Count program captures this species. Covered in the Partners in Flight North American Landbird Conservation Plan.

Approach: Continue monitoring species.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Aspen.

Columbian Sharp-tailed Grouse *Tympanuchus phasianellus columbianus*

WAP 2012 species because of their limited and isolated populations in Nevada and it is moderately vulnerable to climate change

Agency Status	
NV Natural Heritage	G4T3S1
USFWS	No Status
State Prot	Game Birds NAC 503.045
CCVI	Moderately Vulnerable

TREND: The NV population estimate is 220 (NDOW, moderate); declining in NV.

DISTRIBUTION: Small, introduced population in northeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Native bunchgrass and shrub-steppe communities. In western Idaho, preferred big sagebrush habitats with moderate vegetative cover, high plant species diversity, and high structural diversity; in general selected vegetative communities that were least modified by livestock grazing (Saab and Marks 1992). Deciduous shrubs are critical for winter food and escape cover (see Saab and Marks 1992). Bunchgrasses and perennial forbs are important components of nesting and brood-rearing habitat (Saab and Marks 1992).

Dietary requirement includes woody plant buds or fruits in winter.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss and degradation; vegetation changes caused by cattle grazing, agriculture, large destructive fires, and energy development.

NEEDS:

Research Needs: Conduct additional study of winter habitat use and determine fire strategies that potentially benefit the species versus those that do not. Research the success/failure of translocated populations and the response to habitat transitions to uncharacteristic classes.

Monitoring and Existing Plans: NDOW has developed detailed conservation and management priorities as a managed game bird (NDOW 2008).

Approach: Continue monitoring; maintenance and restoration of sagebrush-steppe and montane shrub.

WAP HABITAT LINKS: Sagebrush, Grasslands and Meadows.

Common Loon *Gavia immer*

WAP 2012 species due to the state's Walker Lake stewardship responsibility.

Agency Status	
NV Natural Heritage	G5S2N
USFWS	No Status
USFS-R4	Sensitive
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV migratory population estimate is 300-500; peak of 1,500 in 1996 (NDOW, moderate); trend is decreasing. The Walker Lake survey data set (NDOW) indicates a pronounced decline in number of migrating loons at Walker Lake. Recently average numbers of migrating loons have fallen below 300, and evidence suggests that similar declines have also occurred on Pyramid Lake (Serdehely 2006).

DISTRIBUTION: Migrant throughout Nevada, stages on deepwater lakes.

GENERAL HABITAT AND LIFE HISTORY:

Lakes containing both shallow and deep water areas (McIntyre 1975, 1988; Strong 1985). Water clarity is an important component of breeding habitat selection. Loons are visual predators and generally need clear visibility to at least three to four m (McIntyre 1988), although they can adapt to some conditions of low water clarity (McIntyre 1975). In studies comparing lakes with and without loons, higher turbidity has been suggested as a factor influencing lack of occupancy (Barr 1973, McIntyre 1988).

Dives from surface, feeds mainly on fishes; also amphibians and various invertebrates (Terres 1980).

The Common Loon is a spring and fall migrant through Nevada. Spring migration typically peaks in mid-April in Nevada while fall migration peaks in October. Migration stopover sites are rivers or lakes with adequate food sources that provide opportunities to rest and refuel during migration (McIntyre and Barr 1983). Birds using these stopovers appear to remain for several weeks to meet energy needs for further migration.

CONSERVATION CHALLENGES:

Walker Lake, an important migration stop-over for Common Loons in NV, is threatened by the conversion of the lake from a freshwater to an alkaline/saline system due to inadequate inflows resulting in a decline in fish prey base. This system has also been contaminated by mercury from historic mining operations in the Walker Lake watershed, and high levels of mercury have been documented in loons sampled at the lake. Other stop-over sites in the state appear to be relatively secure for loons.

NEEDS:

Research Needs: Additional efforts to census this species on Lake Mead and Lake Mojave are needed to understand the dynamics of the common loon migration and wintering in that region of the state. Expand current monitoring protocol at Walker Lake to cover a range of survey dates during fall migration, to cover spring migration, and to cover additional lakes known or suspected to be used by loons. Identification of the wintering grounds for the Walker Lake loon population is a high priority and needs to be accomplished before the population disappears. As with loons range-wide, a better understanding of how mercury levels affect loon behavior, including reproductive success, is needed (McIntyre and Barr 1997).

Monitoring and Existing Plans: Currently, loons at Walker Lake are monitored by means of an annual survey that occurs in mid-October each year by NDOW biologists. Some other lakes are monitored on an ad hoc basis by birders (e.g., Pyramid Lake), and Pyramid Lake has been surveyed annually in September by GBBO (for all bird species, including common loon). With the exception of the Walker Lake survey, efforts are not timed to record the peak migration of loons through the state, so may yield equivocal results regarding population trends for this species. Intermountain West Waterbird Conservation Plan. Nevada Comprehensive Bird Conservation Plan.

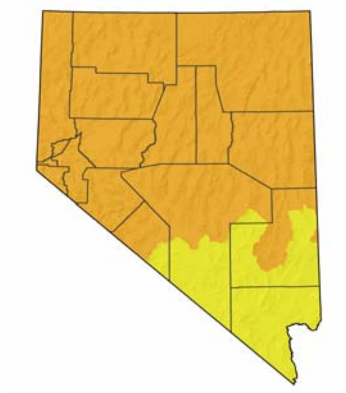
WAP HABITAT LINKS: Lakes and Reservoirs.

Approach: Secure adequate guaranteed inflows for Walker Lake to stabilize its fishery. Maintain good water quality and healthy fisheries in other lakes used by loons (Pyramid Lake, Topaz Lake, and Lake Mead).

WAP HABITAT LINKS: Lakes and Reservoirs.

Common Nighthawk *Chordeiles minor*

WAP 2012 species due to significant declining trends in the U.S., West, and Great Basin and non-significant declining trends in Nevada.



Agency Status	
NV Natural Heritage	G5S5B
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is inconclusive in NV, BBS data suggest long-term slow decline.

DISTRIBUTION: Primarily found across Great Basin region of northern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Found in mountains and plains in open and semi-open habitat; in open coniferous forests, savanna, grasslands, fields, around cities and towns. Nests on the ground on a bare site in an open area. In some areas, also nests on flat gravel roofs of buildings, perhaps related to prey availability at artificial lights. Prefers sandy soil in the southern U.S.

Feeds on flying insects (e.g., mosquitoes, moths, beetles, flies, caddisflies). Forages at night or during the day. Catches insects high in the air or close to the ground. May forage on insects around artificial lights. Young are fed insects by regurgitation.

CONSERVATION CHALLENGES:

Loss of breeding habitat, indiscriminate use of pesticides, and increased predation on nests may be factors contributing to the decline in the species.

NEEDS:

Research Needs: Determine status and trend for Nevada.

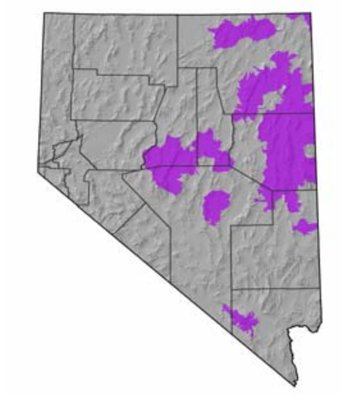
Monitoring and Existing Plans: Not well-sampled by the current NV All Bird Count program.

Approach: Implement a specific nightjar monitoring program throughout the state to better determine distribution, trends, population density, and habitat requirements.

WAP HABITAT LINKS: Intermountain Coniferous Forests and Woodlands, Grasslands and Meadows.

Dusky Grouse *Dendragapus obscurus*

WAP 2012 species due to declining continental and western U.S. trends.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
State Prot	Game Birds NAC 503.045
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: Status and trend in NV is unknown; however estimated 50% declines in western US since 1960s.

DISTRIBUTION: Occurs in central and eastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Primarily a solitary montane species. Coniferous forest, especially fir, mostly in open situations with a mixture of deciduous trees and shrubs (AOU 1983). Spends winter, usually at higher elevation than summer habitat, in conifer forest of various categories of age and tree density; roosts in large conifers with dense foliage. Nests in montane (mixed or deciduous) forest, also in shrubland in some areas. Nests on ground under cover of brush, branches or other vegetation. More inclined than Sooty Grouse to leave the woodlands, ranging up to 2 km [1.2 mi] from the forest edge into areas dominated by sagebrush, montane shrubs, and mountain mahogany, especially in late fall and early winter (NDOW 2008).

In summer feeds on a variety of berries, insects, flowers, and leaves. In the winter feeds mainly on needles and buds of conifers (Douglas-fir often important).

Blue Grouse recently split into two species, Sooty Grouse and Dusky Grouse.

CONSERVATION CHALLENGES:

Little information exists about specific threats. The loss of limber pine, subalpine fir, and montane shrub is of concern. Range conversion by large fires is another likely threat.

NEEDS:

Research Needs: Conduct research to better identify habitat requirements and response to habitat transitions to uncharacteristic classes; delineation of dusky vs. sooty grouse distribution across the state (e.g. Wassuk Range).

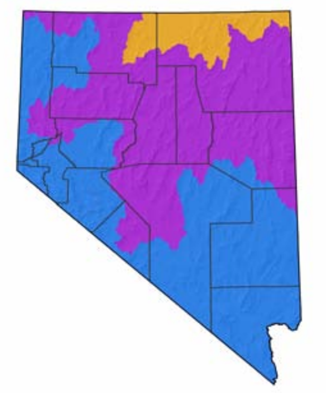
Monitoring and Existing Plans: Not currently monitored but as a game species, NDOW has developed detailed conservation and management priorities for this species. Covered in the Partners in Flight Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Develop conservation plan based on demonstrated need.

WAP HABITAT LINKS: Aspen, Sierra Coniferous Forests and Woodlands, Intermountain Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral, Alpine and Tundra.

Ferruginous Hawk *Buteo regalis*

WAP 2012 species due to potential conflicts with renewable energy development.



Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV breeding population estimate is 1,200 (NBC, moderate); trend is stable.

DISTRIBUTION: Breeding population densest in eastern and central NV, densities thin rapidly west of Eureka County, but extend to the California border north of the Truckee River. Winter concentrations have occurred in agricultural valleys such as Lovelock Valley, usually after extended drought and fallow field time.

GENERAL HABITAT AND LIFE HISTORY:

Habitat includes open country, sagebrush, saltbush-greasewood shrubland, and the periphery of pinyon-juniper and other woodland and desert communities. In NV, nests primarily in live juniper trees. In western NV, also nests on tufa stacks and rock outcrops; sometimes on power line towers; rarely on the ground under thick brush. Lone or peripheral trees are preferred over densely wooded areas (Weston 1968, Lokemoen and Duebbert 1976, Gilmer and Stewart 1983, Woffinden and Murphy 1983, Palmer 1988, Bechard et al. 1990).

Mammals are the primary prey during the breeding season, although birds, amphibians, reptiles, and insects also are taken (Weston 1968, Howard 1975, Fitzner et al. 1977, Blair 1978, Smith and Murphy 1978, Gilmer and Stewart 1983, Palmer 1988, De Smet and Conrad 1991, Atkinson 1992). Jacrabbits are the primary prey species in western shrub-steppe, followed by ground squirrels and pocket gophers (Smith and Murphy 1978, Bechard and Schmutz 1995). Hunts most frequently near sunrise and sunset (Evans 1982). Some types of agricultural production facilitate the increase of ground squirrels and jack rabbits along the agricultural-wild land interface, particularly when drought suppresses production and fields lay fallow through extended periods of time.

CONSERVATION CHALLENGES:

Some habitat has been lost due to agricultural development and type conversion by the invasion of exotic annuals. Sensitive to disturbance during nesting. Vulnerable to shooting on wintering grounds (Harmata 1981, Gilmer et al. 1985). Impacts of indiscriminate or improper pest control are not quantified in NV.

NEEDS:

Research Needs: Understanding of the wintering ecology, dispersal, and site fidelity (breeding and winter) is needed for conservation planning. Other research needs include basic biology and spatial relationships between nesting densities of hawks and prey, especially cyclic species with asynchronous regional peaks. The effects of land management actions on Ferruginous Hawks are also poorly known (Bechard and Schmutz 1995), including responses to wildfire habitat conversion and transitions to uncharacteristic classes.

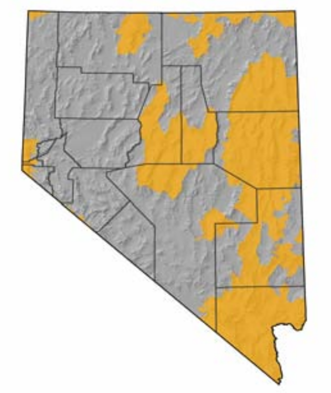
Monitoring and Existing Plans: Monitored by NDOW through aerial nest activity surveys. BBS captures this species, though sample size may be too small for meaningful analysis on the scale of NV. Covered in the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Keys to management are providing suitable nest sites, protecting active nest areas from disturbance, and improving habitat for prey. Limit practices that increase the spread of exotic plant species and the conversion of native shrub-steppe to monotypic stands of annual grass. Prescribed burning may increase habitat suitability in shrub-dominated areas. Isolated nest trees might require protection from livestock in nesting habitat. Mitigate development impacts from mining, pipeline construction, and urbanization (Bechard and Schmutz 1995). Encourage rest-rotation or deferred-rotation grazing systems (Olendorff 1993).

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Sagebrush, Cliffs and Canyons, Salt Desert Shrub, Grasslands and Meadows, Agricultural Lands.

Flammulated Owl *Otus flammeolus*

WAP 2012 species due to rangewide population declines and concerns over conifer habitat with respect to climate change.



Agency Status	
NV Natural Heritage	G4S4B
USFWS	No Status
USFS-R4	Sensitive
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: NV status and trend are unknown.

DISTRIBUTION: Breeds in scattered ranges across the state with coniferous forest, including the Carson Range, Spring Mountains, Schell Creek Range, Ruby Mountains, and Snake Range, among others.

GENERAL HABITAT AND LIFE HISTORY:

Montane forest, usually open conifer forests containing pine, with some brush or saplings (typical of the physiognomy of pre-European settlement ponderosa pine forests). Shows a strong preference for ponderosa pine and Jeffrey pine, throughout its range (McCallum 1994b). Prefers mature growth with open canopy; avoids dense young stands. Found in cooler, semi-arid climate, with high abundance of nocturnal arthropod prey and some dense foliage for roosting (McCallum 1994a). Absent from warm and humid pine forests and mesic ponderosa pine/Douglas-fir (McCallum 1994a, Wright et al. 1997). Most often found on ridges and upper slopes (Bull et al. 1990, Groves et al. 1997). Most often nests in an abandoned tree cavity made by Pileated Woodpecker, flicker, sapsucker or other large primary cavity nester, at heights from 1 to 16 meters (Reynolds et al. 1989). Uses dead, large-diameter pine, Douglas-fir or aspen tree; occasionally uses natural cavity or nest box.

Feeds mainly on nocturnal arthropods, especially owlet moths (Noctuidae), beetles (Coleoptera), and crickets and grasshoppers (Orthoptera). Hunts exclusively at night.

CONSERVATION CHALLENGES:

Vulnerable to loss of large snags and changes to the forest mosaic due to fuel gathering, fuels reduction activities, or large, high-severity fires (expert opinion, GBBO 2010).

NEEDS:

Research Needs: Population trend research is needed. Factors influencing habitat selection in specific NV habitats and response to climate-induced changes in preferred habitats also needed.

Monitoring and Existing Plans: No systematic monitoring occurs for this species. Covered in the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Manage fuels reduction and harvesting activities to conserve large-diameter snags and encourage management activities to include creating or maintaining forests of a mosaic of older trees (especially ponderosa and Jeffrey pine), younger-aged trees, and forest openings with a well-developed shrub layer.

WAP HABITAT LINKS: Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Aspen.

Gilded Flicker *Colaptes chrysoides*

WAP 2012 species due to its restricted range in Nevada and declining trends range-wide.

Agency Status	
NV Natural Heritage	G5S1
USFWS	No Status
PIF	Priority Bird Species
Aud	Red List
CCVI	Presumed Stable

TREND: Status and trend in Nevada is unknown.

DISTRIBUTION: Southern Clark County, small breeding population near Searchlight, NV.

GENERAL HABITAT AND LIFE HISTORY:

Habitat includes stands of giant cactus (saguaro), Joshua tree, and riparian groves of cottonwood and tree willows in warm desert lowlands and foothills (AOU 1995). Nesting density positively correlated with volume of ironwood (Olneya) in southern Arizona (Kerpez and Smith 1990), where it did not nest in saguaros less than 5 m tall (Kerpez and Smith 1990). Assumed association with Joshua tree in NV.

Feeds on insects (ants, beetles, wasps, grasshoppers, grubs, etc). Feeds on the ground or catches insects in the air. Also eats fruits, berries, and seeds (Terres 1980).

CONSERVATION CHALLENGES:

Threats in Nevada are conjectural, but may include impacts to Joshua Trees and other yuccas including development, fire, potential invasion of weeds, and heavy OHV use (GBBO 2010).

NEEDS:

Research Needs: Research needed to better understand status and needs of this species.

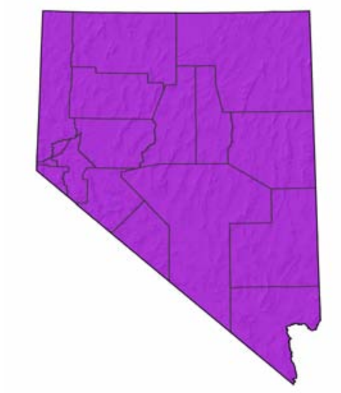
Monitoring and Existing Plans: Nevada Bird Count program and monitoring efforts through the Lower Colorado River MSCP cover this species. Included in the Nevada Comprehensive Bird Conservation Plan.

Approach: Protect habitat from stand-replacing wildfire and development.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub.

Golden Eagle *Aquila chrysaetos*

WAP 2012 species due to Bald and Golden Eagle Protection Act concerns and conflicts with renewable energy development.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 2,400-3,000 (NDOW/NBC, moderate); declines are suspected in the west, but the trend is inconclusive in Nevada.

DISTRIBUTION: Found across NV.

GENERAL HABITAT AND LIFE HISTORY:

Found generally in open country, in prairies, arctic and alpine tundra, open wooded country, and barren areas, especially in hilly or mountainous regions. In NV, nests predominantly on the rock ledge of a cliff; occasionally in a large tree. Pair may have several alternate nests; may use same nest in consecutive years or shift to alternate nest used in different years.

Feeds mainly on small mammals (e.g., rabbits, marmots, ground squirrels). May also eat insects, snakes, birds, juvenile ungulates, and carrion. Rarely attacks large, healthy mammals (e.g., pigs, sheep, deer) (Terres 1980). Can fast for days between feedings. Hunts while soaring or from perch (latter especially used by young). May hunt cooperatively. See Palmer 1988 for further details.

Territory size in several areas of the western U.S. averaged 57-142 sq km (Palmer 1988).

CONSERVATION CHALLENGES:

Vulnerable to reduction of prey populations due to degradation or loss of rangelands to development; wind turbine collisions; potential disturbance activity causing nest abandonment.

NEEDS:

Research Needs: Improve monitoring and survey coverage to generate a current population trend. Research response to habitat conversions and transitions to uncharacteristic classes.

Monitoring and Existing Plans: Statewide nesting inventory by GBBO and NDOW, NBC and NDOW winter raptor surveys capture this species. Covered in the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Habitat management should primarily focus on maintaining prey populations such as jackrabbits, cottontails, and large rodent species; preservation of suitable nest substrates; and reduction of risk of collision with wind turbines.

WAP HABITAT LINKS: Cliffs and Canyons, Sagebrush, Intermountain Cold Desert Scrub, Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Wet Meadows, Lower Montane Woodlands and Chaparral, Alpine and Tundra.

Gray-crowned Rosy-Finch *Leucosticte tephrocotis*

WAP 2012 species because it is highly vulnerable to climate change, its restricted range in Nevada, and concerns over alpine habitat.

Agency Status	
NV Natural Heritage	G5S3N
USFWS	No Status
CCVI	Highly Vulnerable

TREND: Status and trend in NV is unknown.

DISTRIBUTION: Winter resident throughout NV, though absent from the Mojave Desert region.

GENERAL HABITAT AND LIFE HISTORY:

Barren, rocky or grassy areas and cliffs among glaciers or beyond timberline; in migration and winter also in open situations, fields, cultivated lands, brushy areas, and around human habitation (AOU 1983). Nests usually in rock crevices or holes in cliffs.

Forages on the ground for seeds. In the spring gleans wind-transported insects from the snow. Later in the season may glean insects from vegetation or may chase flying insects and catch them in the air.

CONSERVATION CHALLENGES:

Vulnerable to permanent sealing of mine shafts used for winter roost sites.

NEEDS:

Research Needs: Improved population status and distribution data are needed.

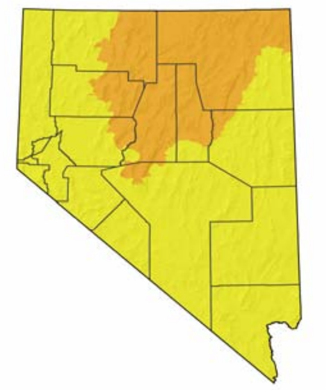
Monitoring and Existing Plans: Captured during the Christmas Bird Count.

Approach: Monitor via Christmas Bird Count and other winter censuses. Survey all potential winter night roost habitats within 8 km of known winter foraging habitats (Bradley 2005). Develop roost conservation strategies, including wildlife-friendly mine closure plans in cooperation with land management agencies and Nevada Division of Minerals as appropriate; develop specific discovery surveys to ascertain breeding status in NV.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Grasslands and Meadows, Cliffs and Canyons, Alpine and Tundra.

Great Basin Willow Flycatcher — *Empidonax traillii adastus*

WAP 2012 species due to declining continental trends and concerns over montane riparian habitat vulnerability.



Agency Status	
NV Natural Heritage	G5T5S1S2
USFWS	No Status
USFS-R5	Sensitive
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: NV trend declining due to severe degradation of required riparian habitat, range-wide decline >20%. Exceedingly rare in recent decades, and historical data from the lower Truckee River indicate that the species was considered abundant in the 1800s, but has not been detected as a breeder recently (Ammon 2002).

DISTRIBUTION: Although this species can be found throughout the Great Basin, it is restricted to riparian areas of high structural complexity in soils that remain saturated through most of the breeding season.

GENERAL HABITAT AND LIFE HISTORY:

In central, eastern, and northern Nevada the species is found in both lowland and montane riparian habitats, and occasionally in other inundated areas such as aspen stands or wet meadows (GBBO 2010). Uses the lower Colorado River corridor during migration (USFWS 2002c). Willows are the traditionally preferred vegetation (Sogge et al. 2010), but other shrub species are also used. Nests in fork or on horizontal limb of small tree, shrub, or vine, at height of 0.6-6.4 m (mean usually about 2-3 m) (Harris 1991), with dense vegetation above and around the nest.

Eats mainly insects caught in flight, sometimes gleans insects from foliage; occasionally eats berries. In breeding range, forages within and occasionally above dense riparian vegetation.

CONSERVATION CHALLENGES:

Highly sensitive to changes in its breeding habitats, especially related to habitat structure and hydrology. Loss, degradation, and fragmentation of lowland riparian habitat due to water diversions and improper riparian grazing by livestock.

NEEDS:

Research Needs: Conduct research on the distribution, trends, population size, subspecies ranges, and specific ecological needs of the Willow Flycatcher in the Great Basin.

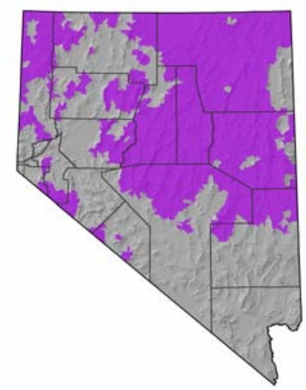
Monitoring and Existing Plans: The NV All Bird Count is covering this species, though their low numbers may require focused area searches. Included in the Partners in Flight North American Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Promote the restoration of riparian systems throughout the Great Basin. Continue intensive monitoring efforts to track population trends in NV.

WAP HABITAT LINKS: Intermountain Riparian.

Greater Sage-Grouse *Centrocercus urophasianus*

WAP 2012 species because it is highly vulnerable to climate change, it is vulnerable to decline due to large-scale habitat conversion and loss, conflicts with energy infrastructure development, and federal listing concerns.



Agency Status	
NV Natural Heritage	G3G4S3
USFWS	C
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Game Birds NAC 503.045
PIF	Priority Bird Species
IUCN	Near Threatened
Aud	Yellow List
CCVI	Highly Vulnerable

TREND: The NV population estimate is 68,000-88,000 (NDOW, moderate); trend is declining.

DISTRIBUTION: Parallels the range and distribution of the sagebrush steppe and Great Basin sagebrush ecosystem types. A 2008 analysis conducted by NDOW estimated that there are 22 million acres of suitable Greater Sage-Grouse habitat.

GENERAL HABITAT AND LIFE HISTORY:

Uses a wide variety of sagebrush mosaic habitats with meadows and aspen in close proximity. Roosts in sagebrush and uses seeps, wet meadows, riparian areas, alfalfa fields, potato fields, and other cultivated and irrigated areas. Leks are located on relatively open sites surrounded by sagebrush, or in areas where sagebrush density is low, such as exposed ridges, knolls, or grassy swales (Schroeder et al. 1999). Nests are located in thick cover in sagebrush habitat and consist of a shallow depression on the ground. Habitat for brood-rearing in early spring is critical to brood survival. Sagebrush overstory, herbaceous understory, and the presence of plentiful insects that provide a high-protein diet for broods (especially Hymenoptera and Coleoptera; species typical of sagebrush upland steppe) are the three important factors (Connelly 1999b). Insects are especially important in the diet of newly hatched broods. Over the fall, birds shift from consuming large amounts of forbs, to eating mostly sagebrush (Wallestad 1975). See Schroeder et al. (1999) for greater detail on diet and food selection.Often winter on windswept ridges kept relatively snow-free under big sage or taller low sage bushes. May sit for weeks under a single bush without moving more than a few feet to feed.

CONSERVATION CHALLENGES:

Most significant threats to sage-grouse in Nevada are natural system modifications due to wildfire and the subsequent loss of habitat combined with impacts of invasive species (cheatgrass) and problematic native species encroachment (pinyon-juniper). Also, habitat fragmentation and disturbance, particularly roads and utility service lines as a result of both renewable and non-renewable energy resources, habitat degradation caused by improper grazing, recreational activities, and loss of upland meadows to mining.

NEEDS:

Research Needs: Further research is needed on effects of fragmentation, area requirements, use of habitat corridors, population movements throughout the seasons, juxtaposition of habitats, the relationship between habitat quality and grouse movements, and differences among populations. The effects of habitat manipulations on grouse also need further study, especially grazing regimes, prescribed fire, and mechanical brush treatments. Basic research on behavior, predation, genetics and other aspects of life history and biology is still needed.

Monitoring and Existing Plans: Extensive monitoring for this species is conducted by NDOW. Covered in the Sage Grouse Conservation Plan for Nevada and Portions of Eastern California, also 6 sub-plans; Partners in Flight Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

WAP HABITAT LINKS: Sagebrush, Grasslands and Meadows, Wet Meadows.

Approach: Ongoing monitoring, both at the core and the periphery of its range, is recommended to continue to document population trends, particularly responses to habitat improvement projects. Identification and conservation/maintenance of priority sage-grouse habitat is essential. Restoration of degraded habitat to expand exiting suitable habitats is also important. Continue to support partnerships, community education programs, and enhanced communication between local area planning groups.

WAP HABITAT LINKS: Sagebrush, Grasslands and Meadows, Wet Meadows.

Le Conte's Thrasher *Toxostoma lecontei*

WAP 2012 species due to declining rangewide trends and concerns over the stability of its Mojave shrub habitat (particularly saltbush flats) in the context of climate change.

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: Nevada population estimate is 100 (expert, moderate); trend is inconclusive.

DISTRIBUTION: Year-round resident in the Mojave Desert of southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Habitat consists of desert scrub, particularly creosote bush associations (AOU 1983), also Atriplex, Opuntia, etc. In NV, seems particularly associated with saltbush flats and wash systems. Nests in cholla, saltbush, small tree, or shrub. Le Conte's Thrasher is part of a nesting guild (including Cactus Wren and Loggerhead Shrike) that may compete for limited nest sites among thorny dense plants (Sheppard 1973). Therefore, areas that contain cholla or similarly desirable nesting substrates may be of particular conservation interest for this species.

Food habits are probably similar to other thrashers that feed on insects, berries, and seeds.

Home ranges in saltbush-cholla scrub averaged 40 hectares. Breeding territories were considerably smaller, averaging 6 hectares. The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates Le Conte's Thrashers are projected to experience a population reduction of 10% over 50 years.

CONSERVATION CHALLENGES:

Sensitive to habitat fragmentation, degradation, or conversion stemming from a variety of disturbances including development (urban, agricultural, or industrial), heavy OHV use, and fire (Sheppard 1996); extended late-summer livestock grazing (Shuford and Gardali 2008); energy development and invasive plants.

NEEDS:

Research Needs: Improve monitoring efforts and generate improved population size and trend estimates; estimate population losses to solar and wind development scenarios and develop mitigation strategies to offset temporary or permanent displacement.

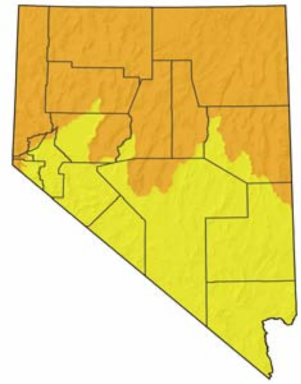
Monitoring and Existing Plans: NV All Bird Count program captures this species. Species is covered in the Partners in Flight North American Landbird Conservation Plan, Clark County MSHCP, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Sensitivity to habitat alteration makes this species a good indicator of habitat quality, therefore, protect occupied habitat at the recommended patch size from habitat conversion and development; maintain corridors of suitable habitat between occupied areas; minimize habitat fragmentation where development occurs focusing on maintaining larger contiguous habitat patches.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub.

Lewis's Woodpecker — *Melanerpes lewis*

WAP 2012 species due to historic population declines and reliance upon aspen/cottonwood riparian areas, a vulnerable habitat type.



Agency Status	
NV Natural Heritage	G4S3
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
Aud	Red List
CCVI	Presumed Stable

TREND: NV population estimate is 13,000 (NBC, moderate); trend unknown; range-wide declines >25% (Rich et al. 2004).

DISTRIBUTION: Year-round resident in northern NV, summer only in northeast, winter resident in the south.

GENERAL HABITAT AND LIFE HISTORY:

Important habitat features include an open tree canopy, a brushy understory with ground cover, dead trees for nest cavities; dead or downed woody debris, perch sites, and abundant insects. Uses open ponderosa pine forests, open riparian woodlands dominated by cottonwood, and logged or burned conifer. In Nevada this species is most strongly associated with deciduous riparian woodlands dominated by aspen or cottonwood (GBBO unpublished NBC data). It is no longer known to breed in the valley-bottom riparian woodlands where they are thought to have historically occurred. A weak excavator, it is even more dependent on dead trees than other woodpeckers. Tends to nest in a natural cavity, abandoned northern flicker hole, or previously used cavity. Mated pair may return to the same nest site in successive years. Key habitat factors include the presence of large, partly-decayed snags, an open forest structure for aerial foraging, and a well-developed shrub or native herbaceous layer that promotes healthy populations of flying insects (Abele et al. 2004).

Feeds on adult emergent insects (e.g., ants, beetles, flies, grasshoppers, tent caterpillars, mayflies) in summer, ripe fruit and nuts in fall and winter. Unlike other woodpeckers, does not bore for insects but will flycatch and glean insects from tree branches or trunks; also drops from perch to capture insects on the ground.

The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates that under the climate model, Lewis's Woodpecker populations are projected to decrease based primarily on losses in aspen/late-open, and aspen woodland/early, but they will gain birds from increases in aspen/mid-closed, with an overall projected loss of 12% statewide.

CONSERVATION CHALLENGES:

Vulnerable to loss of nesting sites (large snags) from logging, natural stand collapse, or degradation of riparian habitats by drought and overgrazing. Fire suppression lengthens fire interval and reduces acreage and frequency of stands of burned dead conifer. Long term cottonwood gallery habitat loss in northern Nevada is a concern.

NEEDS:

Research Needs: A determination of the current status, population trend, and the reasons for declines in recent decades is a high priority. Further study is needed of relationships fire regimes and stand-level habitat characteristics in Nevada. The importance of riparian habitat as a corridor is unknown. May not be very sensitive to patch size and habitat connectivity, but landscape relationships need study.

Monitoring and Existing Plans: Detected on BBS and CBC in sufficient numbers for trend estimates at the broadest scales, but at smaller scales data is inadequate for analysis due to a combination of small sample sizes, sparse distribution of survey routes in appropriate habitats, and the scattered distribution of the species (see Sauer et al. 1996, 1997). The NV Bird Count program captures this species. Covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

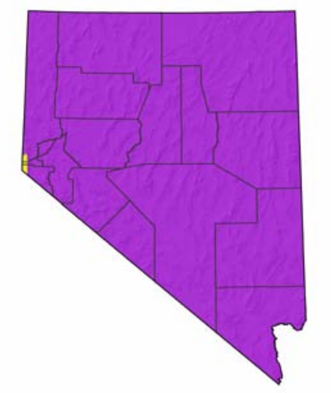
WAP HABITAT LINKS: Intermountain Riparian, Aspen, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral.

Approach: Requires specialized, habitat-specific monitoring due to its quiet habits, erratic distribution, and generally low densities on breeding and wintering grounds (USDA Forest Service 1994, Saab and Rich 1997). Conservation in Nevada should focus on maintaining open-canopied coniferous forests, riparian cottonwood forests and aspen stands with snags, mature trees, shrubby understory, and a productive insect fauna. Conifer burns should leave some standing dead stems on-site to sustain woodpecker foraging and fall naturally.

WAP HABITAT LINKS: Intermountain Riparian, Aspen, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral.

Loggerhead Shrike *Lanius ludovicianus*

WAP 2012 species due to declining rangewide trends.



Agency Status	
NV Natural Heritage	G4S4
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Birds NAC 503.050.3
CCVI	Presumed Stable

TREND: Nevada population estimate is 160,000 (PIF, moderate); declining 5% annually since 1966, on-going significant decline range-wide.

DISTRIBUTION: Resident throughout NV, except Sierras where it may be found in migration.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in open country with scattered trees and shrubs, savanna, desert scrub, and, occasionally, open woodland; often perches on poles, wires or fence posts (AOU 1983). Suitable hunting perches are an important part of the habitat (Yosef and Grubb 1994). Nests in shrubs or small trees.

Feeds primarily on large insects (especially beetles and orthopterans), also other invertebrates, small birds, lizards, frogs, and rodents; sometimes scavenges (Fraser and Luukkonen 1986). Diet varies with season and location. Captures prey usually via a short flight from a perch; sometimes hovers kestrel-like or walks when foraging (Bent 1950, Luukkonen 1987). Sometimes impales food items on a plant thorn or on barbed wire (Fraser and Luukkonen 1986); such items may be eaten later or fed to young (Applegate 1977).

The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates Loggerhead Shrike populations in Nevada are projected to be most negatively impacted by losses of salt desert/mid-late and mountain sagebrush/mid-closed, but are expected to see gains in the habitat types salt desert/shrub/annual, creosote/late, washes/late, and greasewood/shrub/annual, with an overall stable population size.

CONSERVATION CHALLENGES:

Vulnerable to loss of desert scrub and shrub steppe to wildfire-facilitated invasive grass and forblands. May be susceptible to indiscriminant pesticide use.

NEEDS:

Research Needs: Response and tolerance threshold to habitat conversion to invasive grass and forblands; improved habitat suitability modeling is needed.

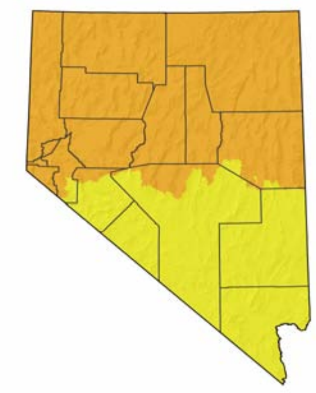
Monitoring and Existing Plans: The NV All Bird Monitoring program and BBS routes capture this species. Covered in the Partners in Flight North American Landbird Conservation Plan and the Clark County MSHCP.

Approach: Maintain suitable nesting and wintering habitat in areas of regular shrike activity. Thorny shrubs, barbed-wire fences, and other objects suitable for impaling prey are also significant features of habitat that should be maintained. Hands et al. (1989) recommended restricting pesticide use in shrike habitat in order to avoid depressing the abundance of potential prey items.

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Lower Montane Woodlands and Chaparral, Grassland and Meadows.

Long-billed Curlew *Numenius americanus*

WAP 2012 species due to historic population declines and concerns of wetland habitat quality.



Agency Status	
NV Natural Heritage	G5S2S3B
USFWS	No Status
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 1,150 (NDOW, moderate); trend is stable.

DISTRIBUTION: Breeds throughout NV north of the Mojave Desert.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in grassy meadows, generally near water (AOU 1983). Nests in moist meadows, on ground usually in flat area with short grass, sometimes on more irregular terrain, often near rock or other conspicuous object. In Nevada, recent study documented nesting in unharvested wet meadows as well as in short grass adjacent to wet meadows when meadows were flooded. Broods move immediately into tall grass in wet meadows after hatching (Hartman and Oring 2009).

Fairly opportunistic. Feeds on various insects (grasshoppers, beetles, caterpillars, etc.), and some berries. During migration also feeds on crayfishes, crabs, snails, and toads. Grasshoppers and carabid beetles are dominant in the chick diet in ID (Redmond and Jenni 1985). May obtain insect larvae by probing into loose soil (Allen 1980). Predation on nestling birds has been observed. Picks food from ground or water, probes with bill in sand or mud in or near shallow water, plucks berries.

CONSERVATION CHALLENGES:

Vulnerable to loss of wet meadows to water diversions, groundwater pumping, or development, in addition to loss of flood-irrigated agricultural fields to habitat conversion. Vulnerable to untimely livestock grazing, haying, or dragging that cause inadvertent nest losses (Dugger and Dugger 2002, Paige and Ritter 1999).

NEEDS:

Research Needs: Response and tolerance threshold to exotic weed invasion into haymeadows.

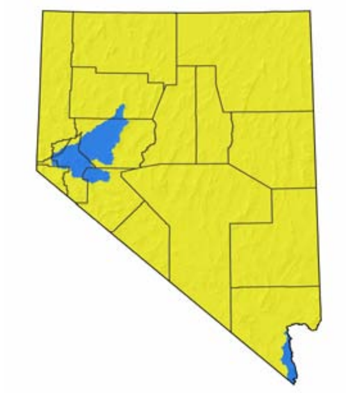
Monitoring and Existing Plans: This species may be captured by the NV All Bird Count (GBBO), but specific area searches of known high quality habitat may also be needed. Covered under the U.S. Shorebird Conservation Plan, Intermountain West Shorebird Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Work with private landowners to accomodate species' life history requirements in private land management strategies.

WAP HABITAT LINKS: Grasslands and Meadows, Wet Meadows, Agricultural Lands.

Long-billed Dowitcher *Limnodromus scolopaceus*

WAP 2012 species due to Nevada's stewardship responsibility for this species during migration.



Agency Status	
NV Natural Heritage	G5S4N
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: Historically, the NV migration population has been estimated at 30,000-100,000. The current migration population estimate is 20,000 (NDOW, moderate); trend is cyclic and declining.

DISTRIBUTION: Migrant throughout NV.

GENERAL HABITAT AND LIFE HISTORY:

Non-breeding birds found in marshes, shores of ponds and lakes, mudflats and flooded fields, primarily in freshwater situations (AOU 1983).

Forages shallow fresh water and mud bars, probing into mud with bill. Feeds on insects and their larvae, mollusks, crustaceans, marine worms, spiders, and seeds of aquatic plants (bulrushes, pondweeds, sedges, etc.).

CONSERVATION CHALLENGES:

Susceptible to water level management that doesn't provide for adequate invertebrate population loading of primary feeding sites corresponding with spring and fall migration periods. Nevada has been known to service as much as 30 percent of the world population (30,000 to 100,000 birds) in peak years.

NEEDS:

Research Needs: Effects of water quality need further research. Determine if possible declines are actual declines or cyclic fluctuation, and research the possible causes.

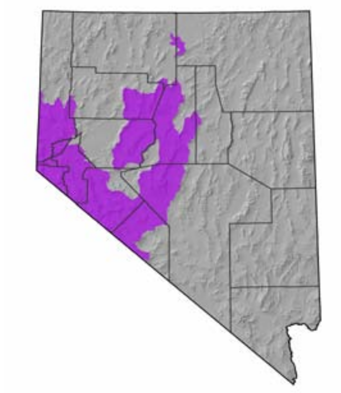
Monitoring and Existing Plans: Monitored through the Nevada Aquatic Bird Count. Covered under the U.S. Shorebird Conservation Plan, Intermountain West Shorebird Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain high quality migrating staging sites through active wetland unit planning and management.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Desert Playas and Ephemeral Pools.

Mountain Quail *Oreortyx pictus*

WAP 2012 species due to uncertain trends and fragmented nature Nevada populations.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
USFS-R4	Sensitive
State Prot	Game Birds NAC 503.045
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 800-1,000 (BBS, moderate); trend is declining.

DISTRIBUTION: Western NV, with scattered, isolated populations in central and north-central NV.

GENERAL HABITAT AND LIFE HISTORY:

Brushy mountainsides, coniferous forest, forest and meadow edges, dense undergrowth, and chaparral. Favors areas with tall dense shrubs, close to water (Brennan et al. 1987). May move to areas with suitable mast crops in fall. Nests on the ground in a shallow scrape lined with plant material. Usually nests under protective cover of a tree, shrubs, fallen branches, etc., within a few hundred meters of water.

In spring and summer feeds on herbaceous vegetation especially leaves, buds, and flowers of legumes) and some insects (grasshoppers, beetles, ants). Eats seeds, acorns, and fruits during the rest of the year (Terres 1980). Chicks eat mainly flower heads, seeds, and relatively few insects. Usually forages in early morning and late afternoon, resting at mid-day.

CONSERVATION CHALLENGES:

Degradation of montane riparian and shrubland habitats due to improper livestock grazing, large, intense fires, invasive plants, water diversions, and fuel reduction projects (Gutierrez and Delehanty 1999).

NEEDS:

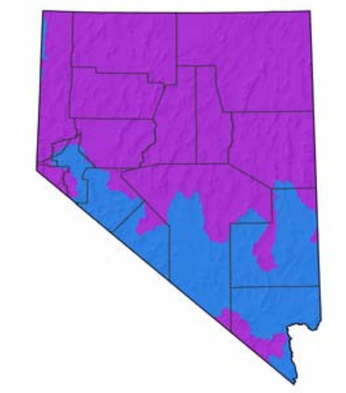
Research Needs: Research is needed to determine response and tolerance thresholds to exotic plant invasion of preferred habitats. Research winter habitat requirements and factors affecting winter survival.

Monitoring and Existing Plans: The NV Bird Count program captures this species, though additional surveys may be needed to increase detection and statistical power. As a managed game bird, detailed conservation and management priorities for this species have been developed by NDOW (NDOW 2008). Covered in the Partners in Flight Landbird Conservation Plan and Nevada Comprehensive Bird Conservation Plan.

Approach: Continue efforts to establish populations within historic range, expand existing populations, and increase connectivity between populations through reintroduction program.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Aspen, Sagebrush.

Northern Goshawk *Accipiter gentilis*



WAP 2012 species because this species is moderately vulnerable to climate change, is sensitive to disturbance, and is reliant upon aspen riparian areas, a vulnerable habitat type.

Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Birds NAC 503.050.3
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The NV population esimate is 700 (BBS, moderate); trend is declining.

DISTRIBUTION: Breeds in northeastern, eastern, central, and western NV, may be found in winter throughout the state.

GENERAL HABITAT AND LIFE HISTORY:

In Nevada, forages in open sagebrush adjacent to riparian aspen stands (Younk and Bechard 1992, cited in Squires and Reynolds 1997). Aspens are a key feature in most of NV, though in the Sierras will use conifers. Nests are generally constructed in the largest trees of dense, large tracts of mature or old growth stands with high canopy closure (60-95 %) and sparse groundcover, near the bottom of moderate slopes, and near water or dry openings (Bull and Hohmann 1994, Daw and DeStefano 2001, Hargis et al. 1994, Reynolds et al 1982, Siders and Kennedy 1994, Squires and Ruggiero 1996, Younk and Bechard 1994). May use same nest in successive years and may use another hawk nest as a base.

Preys on a wide variety of vertebrates and, occasionally, insects. Prey items include tree squirrels, ground squirrels, lagomorphs, and various bird species. During the nesting season, the diet can vary with prey availability.

CONSERVATION CHALLENGES:

In Nevada, decline, degradation, or loss of older age aspen habitats is likely the greatest threat to this species. Fire suppression, improper grazing, and insect and tree disease outbreaks can result in the deterioration or loss of nesting habitat (Graham et al. 1999).

NEEDS:

Research Needs: Update statewide population status and trend; territory life span (years of activity); mate and territory fidelity; adult and juvenile dispersal; variations in diet composition and prey abundance; response of populations to variations in prey abundance; and home range size and plasticity. Need to develop compatible forest and aspen management practices and an effective means of tracking population trends through time.

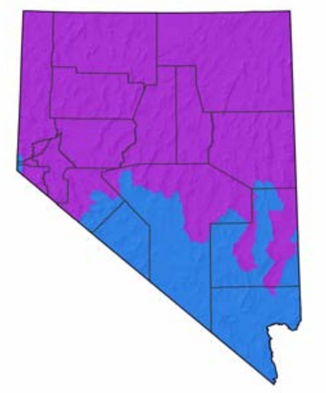
Monitoring and Existing Plans: USFS breeding territory inventory and monitoring (1980-present); NDOW aerial breeding territory inventory and active nest monitoring (1974-present); Regional Plan for the Lake Tahoe Basin: Goals and Policies; LTBMU Forest Plan; Nevada Comprehensive Bird Conservation Plan; Humboldt-Toiyabe Forest Plan Revision; and Watch List Species in the Clark County MSHCP.

Approach: Protection of large, mature to old-growth forest tracts including restoration and enhancement of aspen stands. In addition to forest cover type, other habitat attributes such as stand structure, patch size, landscape features, woody debris, snags, understory vegetation, openings, and canopy closure are important to goshawks and their prey, and therefore must be considered in preserve design (Graham et al. 1999). Habitat patch connectivity and scale is important to consider. Rather than concentrating on breeding home-ranges, entire ecological units (about 100,000 ha (247,105 acres) in extent) need to be managed across vegetation types, land ownership, and political boundaries (Graham et al. 1994). Ecological units need to include a wide variety of forest conditions, from regenerating stands to mature second-growth or old-growth stands (Reynolds et al. 1992). Aspen regeneration should be planned and implemented at a landscape scale with specific provisions for existing goshawk nest territories.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Intermountain Coniferous Forests and Woodlands, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Riparian.

Northern Pintail *Anas acuta*

WAP 2012 species due to both regional and continental historic population declines.



Agency Status	
NV Natural Heritage	G5S5
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 400 breeding and 6,000 wintering (NDOW, moderate); trend in Nevada is stable to slightly increasing; and there is an increasing continental trend.

DISTRIBUTION: Year-round resident across northern NV; winter resident in central and southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Breeds on lakes, rivers, marshes and ponds in grasslands, meadows, or cultivated fields. Most breeding associated with seasonal and semipermanent wetlands (Suchy and Anderson 1987). Often nests near freshwater lakes and ponds, but may nest some distance from water, under cover of low vegetation or in open. Nest is a depression lined with plant material and down. The main seasonal difference in the habitat requirements of Northern Pintails is that during the breeding season, they require a sizable buffer of upland vegetation or other suitable habitat (such as traditional agricultural fields) around waterbodies for nesting (Austin and Miller, 1995). Broods use emergent vegetation for escape cover. In migration and winter found in both fresh-water and brackish situations (AOU 1983). Nevada's primary contribution to Northern Pintail conservation probably occurs during migration and wintering seasons.

Eats various plants and animals, depending on availability. Feeds on seeds and nutlets of aquatic plants (sedges, grasses, pondweeds, smartweeds); also eats mollusks, crabs, minnows, worms, fairy shrimp, and aquatic insects. Animal foods important to females during pre-laying and laying periods. Diet of juveniles includes mostly insects (Suchy and Anderson 1987). Dabbles for food; may also feed on waste grain in fields.

CONSERVATION CHALLENGES:

Breeding Bird Survey data indicate a significant population decrease in North America between 1966 and 1989 (Droege and Sauer 1990); however, trend increasing since 1989. Vulnerable to loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development; haying and other inadvertent agricultural disturbances in upland breeding sites during the nesting period; predation on eggs and nesting females can be substantial in some areas; and susceptibility to avian botulism and cholera (Austin and Miller, 1995).

NEEDS:

Research Needs: Continue surveillance monitoring for avian influenza; continue pre- and post-breeding season banding studies conducted by NDOW in cooperation with the California Department of Fish and Game, the California Waterfowl Association, and the Yukon Delta NWR.

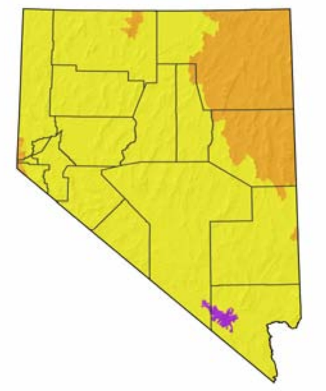
Monitoring and Existing Plans: Annual harvest rates are set by NDOW in consultation with the Pacific Flyway Council. This species is monitored through the NV Aquatic Bird Count, by counts on refuges, NDOW aerial surveys, and NDOW annual waterfowl breeding population (BPOP) surveys. It is covered in the North American Waterfowl Management Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain emergent marsh habitats with open water and suitable nesting habitat in healthy riparian systems. Pursue habitat improvement, restoration, creation and maintenance through partnerships with private landowners and the Intermountain West Joint Venture.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs.

Olive-sided Flycatcher *Contopus cooperi*

WAP 2012 species due to declining trends range-wide.



Agency Status	
NV Natural Heritage	G4S2B
USFWS	No Status
PIF	Priority Bird Species
IUCN	Near Threatened
Aud	Yellow List
CCVI	Increase Likely

TREND: The NV population estimate is 5,600 (NBC, moderate); trend inconclusive, range-wide decline >60%.

DISTRIBUTION: Breeds in coniferous forests in the Sierra Nevada, Spring Mountains, and isolated forests of the mountain ranges of eastern Nevada from Tonopah and Winnemucca to the Utah state line.

GENERAL HABITAT AND LIFE HISTORY:

Habitat includes a variety of forest, woodland, and open situations with scattered trees, especially where tall dead snags are present; subalpine coniferous forest and mixed coniferous-deciduous forest (AOU 1983). Birds also forage along small mountaintop ponds. Nests are placed most often in conifers (Harrison 1978, 1979), on horizontal limbs from 2-15 m from the ground (Harrison 1979, Peck and James 1987). Nevada Bird Count data indicate that Olive-sided Flycatchers are most often found in areas where >50% of the landscape is covered by coniferous forest. NBC data also show that except in western Nevada, they may occasionally breed in aspen and pinyon-juniper woodlands that are relatively distant from coniferous forests. Densities and frequencies of occurrence in these alternate habitats tend to be lower than in coniferous forests.

The diet is made up almost entirely of flying insects, and this bird has a special fondness for wild honeybees and other Hymenoptera (Forbush 1927, Bent 1942, Terres 1980). Forages primarily by hovering or sallying forth, concentrating on prey available via aerial attack. Generally launches these aerial attacks from a high, exposed perch atop a tree or snag.

Usually territorial in nonbreeding areas (Stiles and Skutch 1989) and may display strong year-to-year site fidelity on the breeding (Altman 1997) and wintering grounds (Marshall 1988, Altman 1997). Possibly because of their dependence upon flying insects as prey, these birds arrive rather late on their breeding grounds. Olive-sided flycatchers are early fall migrants. The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates that based on the relatively small sample size to run through the TNC (2011) climate model, the population is projected to be stable over the next 50 years.

CONSERVATION CHALLENGES:

In the Sierra Nevada region it is likely that fire suppression has reduced the frequency of smaller fires that create the forest openings preferred by this species. Habitat loss and degradation on the flycatcher's wintering grounds in South and Central America may be contributing to the species decline (Altman and Sallabanks 2000).

NEEDS:

Research Needs: Continue monitoring to determine trends in Nevada, and to obtain better estimate of population size. Search for Olive-sided Flycatchers in mountain ranges where there is currently no breeding evidence; determine distribution and population densities in eastern Nevada limber pine stands. Create habitat suitability modeling for non-Sierra habitats. Investigate the role of fire intensity, scale, and frequency in creating suitable habitat for Olive-sided Flycatchers, and develop fire management strategies based upon these findings.

Monitoring and Existing Plans: Captured through the Nevada All Bird Count. Covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

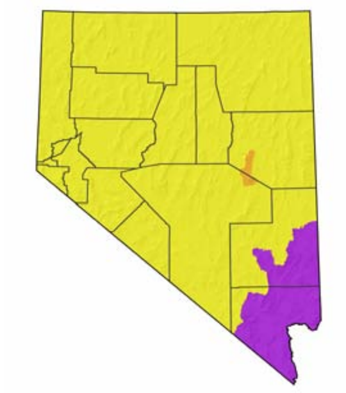
WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Intermountain Coniferous Forests and Woodlands, Intermountain Riparian.

Approach: Maintain old growth and mature coniferous forest stands in blocks of 20 hectares or greater when possible; otherwise maintain occupied stands at whatever the size. Retain snags when logging in known inhabited areas. Implement silvicultural practices that mimic natural disturbances, e.g., small-patch clearcuts that leave snags and trees and selection cuts. Retain some standing dead trees of varying heights after a fire and leave some areas unsalvaged. Some retained snags should be as tall as the canopy or extend above it.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Intermountain Coniferous Forests and Woodlands, Intermountain Riparian.

Peregrine Falcon *Falco peregrinus*

WAP 2012 species due to ESA recovery monitoring requirements.



Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Endangered Birds NAC 503.050.2
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 140-180 (NDOW, moderate); trend is increasing.

DISTRIBUTION: Occurs throughout the state; however nesting since 1960 has only been confirmed in Clark, White Pine, and Lincoln Counties.

GENERAL HABITAT AND LIFE HISTORY:

Utilizes various open environments including open water, desert shrub, and marshes usually in close association with suitable nesting cliffs; also mountains, open forested regions, and human population centers (AOU 1983). When not breeding, occurs in areas where prey concentrate, including marshes, lake shores, rivers and river valleys, cities, and airports. In Nevada, often nests on a ledge or hole on face of rocky cliff or crag; also uses ledges of city high-rise buildings. On cliffs, nest ledges are commonly sheltered by an overhang (Palmer 1988, Campbell et al. 1990). See Grebence and White (1989) for information on nesting along the Colorado River system.

Feeds primarily on birds (medium-size passerines up to small waterfowl); rarely or locally, small mammals (e.g., bats), lizards, fishes, and insects (by young birds) may be taken. Prey pursuit initiated from perch or while soaring. May hunt up to several km from nest site (Skaggs et al. 1988).

CONSERVATION CHALLENGES:

Vulnerable to loss of wetland habitat of primary prey and food chain contamination from use of persistent pesticides. Pesticide-caused reproductive failure now apparently is rare or absent in northern populations, though organochlorine levels in the environment are still high in some areas (e.g., NM, Hubbard and Schmitt 1988; see also Peakall 1990; see Banasch et al. 1992 for information on contaminants in prey in Panama, Venezuela, and Mexico). Studies suggest that falcons continue to be exposed to environmental contaminants (e.g., Steidl et al. 1991). Energy development (wind and solar) may impact foraging areas and migration corridors.

NEEDS:

Research Needs: Conduct exploratory surveys for new breeding activity. Determine prey preferences for Colorado River breeding pairs and assess the influences of water level management in Lake Mead and Lake Mojave on the maintenance and availability of preferred prey populations.

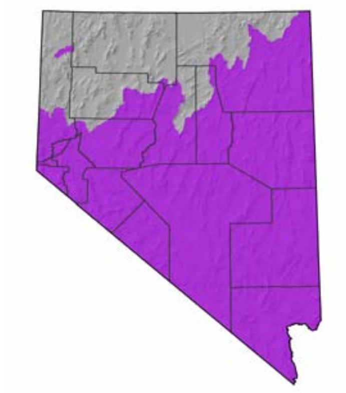
Monitoring and Existing Plans: The USFWS has proposed to monitor selected populations annually for 5 years or more to verify the continued recovery of this species. NDOW partners with NPS to conduct monitoring in NV. BBS also captures this species, though sample size may be too low for meaningful analysis on the scale of NV. Regional Plan for the Lake Tahoe Basin: Goals and Policies. Humboldt-Toiyabe Forest Plan Revision. LTBMU Forest Plan. Clark County MSHCP Covered Species. Nevada Comprehensive Bird Conservation Plan.

Approach: Manage habitat near known or likely nesting locations and consistently-used migratory sites for avian prey productivity. Protect known nesting cliffs or structures and adjacent foraging habitat from disturbance. Encourage seasonal closures of recreational climbing routes near known nest locations on managed lands.

WAP HABITAT LINKS: Cliffs and Canyons, Developed Landscapes, Marshes.

Pinyon Jay *Gymnorhinus cyanocephalus*

WAP 2012 species due to rangewide population declines.



Agency Status	
NV Natural Heritage	G5S3S4
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
IUCN	Vulnerable
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 428,000 (NBC, moderate); there has been a 9.9% annual decrease since 1966; and the BBS indicates 50% range-wide decline.

DISTRIBUTION: Permanent resident in NV where pinyon is present.

GENERAL HABITAT AND LIFE HISTORY:

Pinyon-juniper woodland, less frequently pine; in nonbreeding season, also occurs in scrub oak and sagebrush (AOU 1983). Nests in shrubs or trees (e.g., pine, oak, or juniper), about 1.5-9 m (5-29.5 ft) above ground. Nests when and where adequate numbers of pine seeds are available.

Eats pinyon and other pine seeds, berries, small seeds, and grain. Also insects (larvae, nymphs, and adults); beetles, grasshoppers, caterpillars, ants, etc. May eat bird eggs, hatchlings. Communally caches large numbers of seeds.

Lives in loose flocks of multiple breeding pairs and their offspring from previous nesting seasons. The flock has an established home range but may wander to other areas in search of food. During nesting season flocks of yearlings may form. GBBO radio-telemetry study found that foraging Pinyon Jays appeared to favor transitional areas where pinyon-juniper woodland is interspersed with sagebrush. During the daytime, jays were usually found within 800m [2,600 ft] of woodland edge, and always within 2 km [1.2 mi] of the edge. Roosting and nesting, jays went deeper (but usually no more than 3 km [1.8mi]) into the woodland interior to denser tree stands. Jays were nearly always found in areas with diverse woodland canopy closure and age structure; they were not observed in large contiguous areas of mature, dense woodland. Although very large flocks have been reported elsewhere, the telemetry study most often observed smaller subflocks (<30 birds) that periodically joined other subflocks to form flocks of 50-100 birds. Subflock home ranges were <20 km sq [5,000 ac] in all cases. The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates Pinyon Jay populations are projected to experience losses from habitat change in mountain sagebrush/mid-closed, big sagebrush/shrub/annual, and pinyon-juniper, and they are expected to gain birds in Wyoming big sagebrush/late, pinyon-juniper/late, and mountain sagebrush/late-open, for an overall projected population decline of 19%.

CONSERVATION CHALLENGES:

Preliminary data suggest that Pinyon Jay declines may be at least partly related to substantial increases in the acreage of closed-canopy, mature (or senescent) woodland with a poor shrub understory, coupled with a corresponding loss of mixed-age woodland mosaics with openings and a complex shrubland edge. These landscape scale changes are largely the result of altered fire regimes, although grazing pressure and invasive plants may be contributing factors.

NEEDS:

Research Needs: Continue monitoring for population trends. Additional studies need to be conducted to confirm, refine, or revise the preliminary findings derived from the radio-telemetry studies done by GBBO. In depth studies of the landscape-scale successional processes that may impact or control pinyon pine nut production and the potential impacts of climate change on pinyon nut production are needed.

Monitoring and Existing Plans: The NV All Bird Count program captures this species. Covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

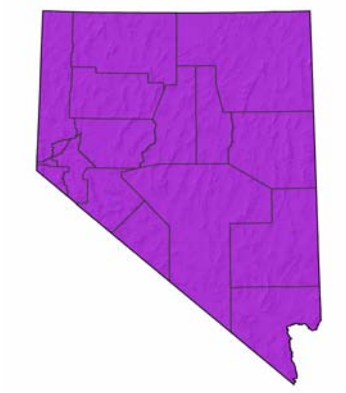
WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral.

Approach: Develop successful protocol for locating nesting colonies and develop a predictive model for the identification of suitable nesting colony habitat. Maintain or increase the proportion of pinyon-juniper woodland that is characterized by mixed-age structure, woodland openings, interspersion with sagebrush habitat, and well-developed shrub understory. An ideal landscape would contain (within a patch size of ~3,000 ha [7,400 ac]) mature cone-bearing trees, some dense closed-canopy stands near the woodland edge, and large numbers of younger trees interspersed with shrubland. Pinyon-juniper treatment projects should try to avoid creating a sharp, well-defined edge between dense woodland and recovered shrubland.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral.

Prairie Falcon — *Falco mexicanus*

WAP 2012 species due to potential conflicts with renewable energy development.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 11,500 (NBC, moderate); trend is inconclusive.

DISTRIBUTION: Resident statewide.

GENERAL HABITAT AND LIFE HISTORY:

Preferred landscapes are cliffs adjacent to arid valleys with low vegetation. Often observed foraging over a variety of sagebrush, salt desert, and Mojave scrub shrublands throughout the year, and they also occur in agricultural lands, especially during the winter months (GBBO 2010). Typically nests in pot hole or well-sheltered ledge on rocky, vertical cliff or steep earth embankment, 10 to more than 100 meters above base. May nest in man-made excavations on otherwise unsuitable cliffs (Cade 1982). Nests typically are placed on south-facing aspects, with overhangs offering some protection from solar radiation. May use old nest of raven, hawk, eagle, etc. Commonly changes nest site within territory in successive years (see Palmer 1988). In Mojave Desert, remote nests had higher productivity than did nests that were closer to human activity (Boyce 1988). Generally prefer to forage over open areas of early successional stages, low vegetation height, and bare ground.

Primarily feeds opportunistically on mammals (especially ground squirrels), lizards, snakes, and birds, generally up to size of quail and rabbits. Usually captures prey on or near ground. May cache prey in vegetation, on ledge, or in small crevice or cavity; caching most common during early brood rearing.

CONSERVATION CHALLENGES:

Conversion of rangeland habitats to exotic grasslands and forblands; indiscriminate poisoning of ground squirrels; and changes in agricultural practices that reduce fallow field acreages and duration.

NEEDS:

Research Needs: Studies of responses and tolerance thresholds to rangeland transitions to uncharacteristic classes (e.g., exotic grasslands, forblands, rabbitbrush) are needed.

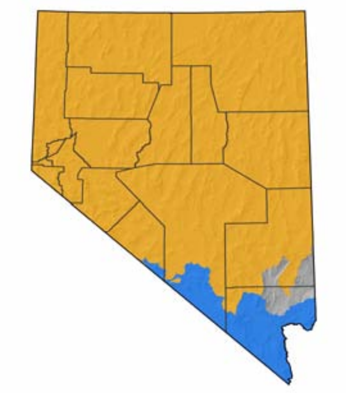
Monitoring and Existing Plans: NV All Bird Count captures this species. Covered in the Nevada Comprehensive Bird Conservation Plan.

Approach: Continue monitoring to better estimate ongoing population trend and population size. Where possible, maintain a disturbance-free buffer zone around nesting cliffs. Manage shrublands in the vicinity of cliffs to maintain or restore habitat-appropriate understory cover and control invasive weeds (GBBO 2010).

WAP HABITAT LINKS: Cliffs and Canyons, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Intermountain Cold Desert Scrub, Grasslands and Meadows, Alpine and Tundra, Agricultural Lands.

Redhead *Aythya americana*

WAP 2012 species due to both regional and continental historic population declines.



Agency Status	
NV Natural Heritage	G5S4B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 200 breeding and 5,000 wintering (NDOW, moderate); trend is cyclic, but stable to increasing.

DISTRIBUTION: Breeds throughout NV, except Mojave Desert where it is a winter resident.

GENERAL HABITAT AND LIFE HISTORY:

Nests in large freshwater marshes (semipermanently and seasonally flooded palustrine wetlands) with persistent emergent vegetation; optimum nesting conditions are wetlands that are 2 ha (5 acres) or more and <0.4 km (0.25 miles) from a large permanent or semipermanent lake; nests usually are placed in dense bulrush or cattail stands that are interspersed with small areas of open water usually within 3-4m. Broods use shallow ponds if emergent vegetation is available for escape cover; ideally these should have high invertebrate populations; later, access to deeper water with ample pondweeds is important (Custer 1993). After nesting, many move to large lakes to molt (Custer 1993).

Diet includes tubers, rhizomes, seeds, other parts of aquatic plants, and aquatic invertebrates, including insects, crustaceans, and mollusks (Custer 1993). Usually feeds in mornings and evenings; may feed at night.

CONSERVATION CHALLENGES:

Loss and degradation of marsh and open water habitat due to water diversions, declines in water quality, or development (Shuford and Gardali, 2008). Drought and low water conditions adversely affect breeding success and increase predation pressure (Woodin and Michot, 2002).

NEEDS:

Research Needs: Determine response to changes in marsh vegetation and structure affected by climate change.

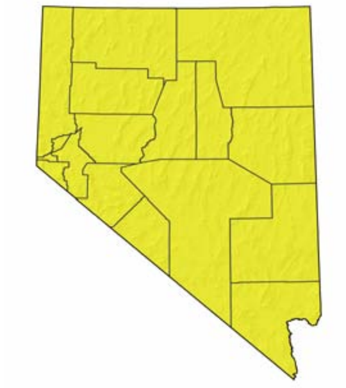
Monitoring and Existing Plans: This species is monitored through the NV Aquatic Bird Count, surveys conducted by refuge biologists, NDOW aerial surveys, and NDOW annual waterfowl breeding population (BPOP) surveys. It is covered in the North American Waterfowl Management Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Because Redheads are relatively flexible in their habitat use, habitat management strategies that benefit other ducks are likely to benefit Redheads as well. However, their requirement for relatively deep summer water (>1m; [3 ft]) does make them vulnerable to changes in water levels (Shuford and Gardali, 2008; Woodin and Michot, 2002). In breeding marshes, maintain a consistent water level during the nesting period (1 May - 15 July). Improve, create, restore, and maintain habitat through partnerships with private landowners, Ducks Unlimited, and the Intermountain West Joint Venture.

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs.

Red-necked Phalarope *Phalaropus lobatus*

WAP 2012 species because it is moderately vulnerable to climate change, arctic breeding populations are declining, and migration stewardship responsibility.



Agency Status	
NV Natural Heritage	G4G5S4M
USFWS	No Status
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The NV migration population estimate is 3,000 (NDOW, moderate); trend is cyclic and highly variable.

DISTRIBUTION: Migrant throughout NV.

GENERAL HABITAT AND LIFE HISTORY:

Occurrs in Nevada during migration on ponds, lakes, open marshes (AOU 1983), and sewage ponds, particularly saline and hypersaline lakes (e.g., Big Soda Lake, Walker Lake). There is a large migration staging population at Mono Lake, CA not far from NV.

Feeds on plankton, insects (larvae and adults), crustaceans, and mollusks. Feeds on water, often whirling around in circles (Terres 1980); also may pick food from emergent stones and vegetation. In fall migrations at Mono Lake, CA, they concentrate near shore and feed on brine flies (Jehl 1986).

CONSERVATION CHALLENGES:

Vulnerable to loss or degradation of marshes, ponds, and lakes due to water diversions, declines in water quality, or development.

NEEDS:

Research Needs: Improved global population estimate and improved Great Basin region migration estimate are needed.

Monitoring and Existing Plans: Monitored through the Nevada Aquatic Bird Count. Covered under the US Shorebird Conservation Plan, Intermountain West Shorebird Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain high quality migration staging sites through active wetland unit planning and management.

WAP HABITAT LINKS: Lakes and Reservoirs, Marshes, Desert Playas and Ephemeral Pools.

Rufous Hummingbird *Selasphorus rufus*

WAP 2012 species due to rangewide population declines and climate change concerns over high-elevation riparian and alpine habitats.

Agency Status	
NV Natural Heritage	G5S3M
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: Status and trend in NV are unknown; continental decline reported by BBS.

DISTRIBUTION: Migrant throughout NV; breeding in highest elevations of the state possible but not yet documented.

GENERAL HABITAT AND LIFE HISTORY:

In migration and winter, found in open situations where flowers are present (AOU 1998). During southward migration, will use mountain meadows, disturbed habitats, and hummingbird feeders.

Feeds on nectar, insects, and tree sap from sapsucker wells. Uses wide variety of flowers, including columbine, scarlet gilia, penstemons, paintbrushes, sage, lilies, larkspurs, heaths, currants, salmonberry, honeysuckles, fireweed, horsemint, toad-flax, snapdragon, and bee-flower (Calder 1993). Insect prey items include gnats, midges, whiteflies, and aphids which provide an important source of fat, protein, and salt.

Aggressive in defense of feeding and nesting territory both inter- and intraspecifically (Cody 1968; Baltosser 1989; Calder 1993). Will establish and defend territories around nectar sources on breeding sites, migration stopovers, and wintering sites. Stopover habitats critical to refueling for this hummingbird's metabolism.

CONSERVATION CHALLENGES:

Possibly vulnerable to destruction or degradation of habitat that significantly reduces abundance of blooming plants during fall migration, including plant phenological changes affected by climate change.

NEEDS:

Research Needs: Investigate possibility of breeding in northeast Nevada and other high-elevation sites; pursue a fall migration monitoring effort that would allow determination of migrant population size, trends, and habitat use. Study the impacts of changes in fall flowering plant availability affected by climate change.

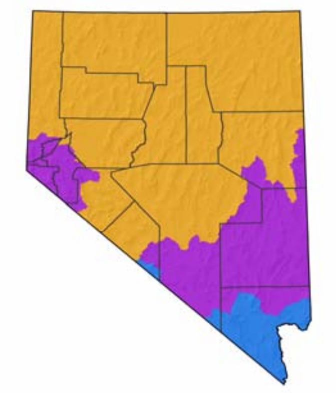
Monitoring and Existing Plans: Rufous Hummingbirds in fall migration are poorly monitored by the breeding-season NBC program. Covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Manage primary habitats to encourage structural and floristic diversity that results in patches of high forb/flow density, particularly during spring and fall migration.

WAP HABITAT LINKS: Grasslands and Meadows, Aspen, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Alpine and Tundra.

Sage Sparrow *Amphispiza belli*

WAP 2012 species because it is moderately vulnerable to climate change and due to the possibility of large-scale sagebrush habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5S4B,S4N
USFWS	No Status
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Moderately Vulnerable

TREND: The NV population estimate is 2.9 million (NBC, moderate); trend is stable in NV and range-wide.

DISTRIBUTION: Breeds throughout NV north of the Mojave Desert, winters in southern NV and extreme southwestern NV.

GENERAL HABITAT AND LIFE HISTORY:

Strongly associated with sagebrush for breeding. Also found in salt-bush brushland, shadscale, antelope brush, rabbitbrush, mesquite, and chaparral (AOU 1998; Green and Smith 1981; Martin and Carlson 1998; Paige and Ritter 1998; Reynolds 1981). Prefers semi-open habitats, shrubs 1-2 m tall (Martin and Carlson 1998). Nests on the ground or in a shrub, up to about 1 m above ground (Terres 1980). In the Great Basin, usually nests in living sagebrush where cover is sparse but shrubs are clumped (Petersen and Best 1985). Placement may be related to density of vegetative cover over the nest, as will nest higher in a taller shrub (Rich 1980). In migration and winter also in arid plains with sparse bushes, grasslands and open situations with scattered brush, mesquite, and riparian scrub; preferring to feed near woody cover (Martin and Carlson 1998; Meents et al. 1982; Repasky and Schluter 1994). Flocks in Mojave Desert appear to follow water courses (Eichinger and Moriarty 1985). Wintering birds in honey mesquite of lower Colorado River select areas of higher inkweed density (Meents et al. 1982).

Feeds on insects, spiders and seeds (especially in the winter). Runs along the ground stopping to pick up food.

The GBBO (2011) analysis of bird population responses to projected effects of climate change demonstrated a significant negative sensitivity to invasion of sagebrush habitat by pinyon-juniper. The analysis also indicates Sage Sparrow populations are projected to be most affected by reductions in mountain sagebrush/mid-closed and salt desert/mid-late covers, but are expected to see population gains in salt desert/shrub/annual covers, for a projected statewide population reduction of 20%.

CONSERVATION CHALLENGES:

Sage Sparrows are negatively affected by factors that reduce the shrub component in their preferred habitats including fire, cheatgrass invasion, expansion of pinyon-juniper woodland into shrubland, heavy OHV use (GBBO 2010), and urban and suburban development.

NEEDS:

Research Needs: Further research is needed on Sage Sparrow subspecies delineation throughout its range. Understanding of minimum patch sizes, fragmentation effects, spatial juxtaposition of habitat patches, and other aspects of landscape ecology are needed to accurately assess the effects of applied range restoration techniques in sagebrush (e.g. prescribed fire, mechanical and chemical brush control). Conduct additional research to ascertain responses and tolerance thresholds to pinyon-juniper encroachment into sagebrush habitats and responses and tolerance thresholds to habitat transitions to other uncharacteristic classes (e.g., annual grass and rabbitbrush).

Monitoring and Existing Plans: This species is captured by the NV All Bird Count and the BBS program. Species is covered in the Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

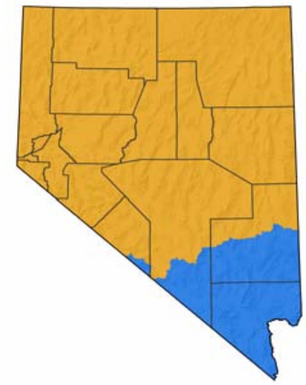
WAP HABITAT LINKS: Sagebrush, Intermountain Cold Desert Scrub.

Approach: Protect large expanses of high-quality sagebrush and mixed xeric shrub (saltbush, hopsage) from wildfire. Where pinyon-juniper encroachment is known to have recently occurred within high-quality sagebrush habitat, conduct pinyon-juniper removal projects. The species can likely persist with moderate grazing and other land management activities that maintain shrub cover.

WAP HABITAT LINKS: Sagebrush, Intermountain Cold Desert Scrub.

Sage Thrasher *Oreoscoptes montanus*

WAP 2012 species because it is moderately vulnerable to climate change and due to the possibility of large-scale sagebrush habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5S5B
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Birds NAC 503.050.3
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The NV population estimate is 1.5 million (NBC, moderate); trend may be stabilizing after a significant historical decline between 1966-99 (BBS 2011).

DISTRIBUTION: Primarily Great Basin region of Nevada, breeding range extends southward into the northern Mojave region in areas where sagebrush habitat is present.

GENERAL HABITAT AND LIFE HISTORY:

In northern Great Basin, breeds and forages in tall sagebrush/bunchgrass, juniper/sagebrush/bunchgrass, mountain mahogany/shrub, and aspen/sagebrush/bunchgrass communities (Maser et al. 1984). Positively correlated with shrub cover, shrub height, bare ground, and horizontal heterogeneity (patchiness); negatively correlated with spiny hopsage, budsage, and grass cover (Rotenberry and Wiens 1980, Wiens and Rotenberry 1981). Usually nests within 1 meter of ground in fork of shrub (almost always sagebrush); sometimes nests on ground (Harrison 1978, Reynolds 1981, Rich 1980). In winter, uses arid and semi-arid scrub, brush and thickets.

Feeds on a wide variety of insects, including grasshoppers, beetles, weevils, ants, bees, etc. Also feeds on fruits and berries.

The GBBO (2011) analysis of bird population responses to projected effects of climate change demonstrated a decline in Sage Thrasher density in pinyon-juniper-encroached sagebrush habitats, although the response was not as severe as that of Sage Sparrow. Analysis also indicates that Sage Thrasher is expected to be most affected by projected losses in mountain sagebrush/mid-closed, big sagebrush/mid-open, and salt desert shrub/late covers, and is expected to gain some birds in salt desert shrub/annual, Wyoming big sagebrush/late, and greasewood/shrub/annual covers, for a total projected statewide population loss of 21%.

CONSERVATION CHALLENGES:

Loss, degradation, or fragmentation of high-quality sagebrush shrubland due to fire, invasive plants, expansion of pinyon-juniper woodland into sagebrush, improper livestock grazing and excessive OHV use (GBBO 2010).

NEEDS:

Research Needs: Study to determine Sage Thrasher's patch size requirements, and to better quantify its sensitivity to patch size in order to more accurately assess responses to applied range restoration techniques in sagebrush (e.g., prescribed fire, mechanical and chemical brush control). Further research is needed to determine responses and tolerance thresholds to pinyon-juniper encroachment into sagebrush habitats.

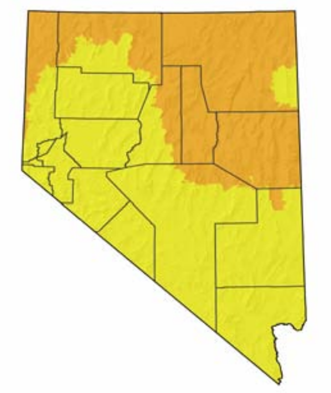
Monitoring and Existing Plans: Captured in the NBC program and covered in the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain large, continuous areas of high-quality sagebrush habitat. Develop sagebrush rangeland restoration techniques that allow for Sage Thrasher adjustment to treated areas at local and landscape scales [(e.g., applied brush control in mosaics on three-stage timetables that preserve old, tall big sage on the landscape until initial treatments have recovered to suitable Sage Thrasher habitat (20-30 years recovery time)] (Neel et al., unpub. 2007).

WAP HABITAT LINKS: Sagebrush, Intermountain Cold Desert Scrub.

Sandhill Crane *Grus canadensis*

WAP 2012 species due to concerns over riparian habitat stability.



Agency Status	
NV Natural Heritage	G5S2B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 650-1,000 (NDOW, USFWS, moderate); trend is stable to increasing in Nevada, although low recruitment has occurred in some years and should be monitored (Drewien et al. 1995, Ivey and Herziger 2006).

DISTRIBUTION: Breeds in northeastern, east-central, and western Nevada. Also congregates in large numbers in migration in eastern Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Open grasslands, marshes, marshy edges of lakes and ponds, river banks (Terres 1980). Nests on the ground or in shallow water on large mats of vegetation, bogs, fens, or wet forest meadows. Exhibits high fidelity to breeding territories (see Littlefield 1995). Roosts at night along river channels or natural basin wetlands. Often feeds and rests in fields and agricultural lands.

Feeds on roots, tubers, seeds, grain, berries, small vertebrates (mice, lemmings, birds, snakes, lizards, etc.), earthworms, and insects. Forages in marshes, meadows, pastures, and fields (Terres 1980). Most food items are obtained on the surface of the ground or among low vegetation; also may use bill to dig out roots, tubers, and frogs. Feeding in fields occurs primarily on excess grains in non-breeding areas. Young forage for invertebrates during first few weeks of life.

Gregarious in winter and in migration. Migratory populations begin moving north late February to mid-March. Nevada breeding cranes belong to the subspecies G. c. tabida, the Greater Sandhill Crane. Within this subspecies, there are two distinct populations, named for their wintering grounds, the Lower Colorado River Valley population (LCRVP) in northwestern and central Nevada, and the Central Valley population (CVP) in western Nevada.

CONSERVATION CHALLENGES:

Loss or degradation of wet meadow, marsh, and riparian habitat due to habitat conversion (agriculture, gravel operations, development, etc.), water diversions, possible impacts of groundwater pumping in occupied areas, heavy livestock grazing during nesting and fledging season, particularly in wet meadows, and invasive plants. Also, loss of traditional crop agriculture in migration stopover sites, and early haying may impact nests or young. Effects of predator populations have been noted, but predator control efforts do not always result in increased crane productivity (Laca et al. 2008).

NEEDS:

Research Needs: Responses and tolerance thresholds to exotic plant invasion into riparian meadows. Update subpopulation dynamics and degree of mixing on breeding grounds between several delineated subpopulations.

Monitoring and Existing Plans: NDOW conducts a tri-annual aerial survey for breeding pairs. Covered in the Intermountain West Waterbird Conservation Plan, Pacific Flyway Management Plan: Lower Colorado River Population of Greater Sandhill Cranes, and the Nevada Comprehensive Bird Conservation Plan.

WAP HABITAT LINKS: Grasslands and Meadows, Wet Meadows, Marshes, Intermountain Riparian, Agricultural Lands.

Approach: The majority of Nevada's cranes depend significantly upon habitat on privately-owned lands; therefore, partnerships with agricultural landowners to manage and maintain nesting and staging areas, wet meadows and pastures, and to delay haying operations until post fledging are essential. Provide nesting/security cover in nesting areas. Facilitate the maintenance of open space through community planning and conservation easements where development threatens crane habitat. Some predator control may be necessary, especially where local coyote populations have demonstrated a focus on Sandhill Crane colts as a prey item.

WAP HABITAT LINKS: Grasslands and Meadows, Wet Meadows, Marshes, Intermountain Riparian, Agricultural Lands.

Scott's Oriole *Icterus parisorum*

WAP 2012 species due to declining population trends in Nevada and its preferred habitat is sensitive and vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5S4B
USFWS	No Status
CCVI	Presumed Stable

TREND: The NV population estimate is 60,000 (PIF, moderate); trend in NV is inconclusive, but BBS data indicate a significant population decrease in California since 1966.

DISTRIBUTION: Breeds primarily in southern NV extending north and east with pinyon-juniper in low densities possibly as far as Ruby Valley.

GENERAL HABITAT AND LIFE HISTORY:

Joshua tree (yucca), pinyon-juniper, arid oak scrub and palm oases (upper Tropical to lower Temperate zones) (AOU 1983). Foothills, desert slopes of mountains, and more elevated semi-arid plains (Bent 1958). Nests in trees or yuccas, 1-6 m above ground.

Feeds on insects (grasshoppers, beetles, caterpillars, etc.), fruit (cactus fruit and berries), and nectar. Forages in foliage for insects and berries.

The GBBO (2011) analysis of bird population responses to projected effects of climate change indicates Scott's Orioles are projected to decrease primarily in areas where blackbrush/early, washes, and blackbrush-mesic/late decline, and increase with increases in blackbrush/shrub/annual and blackbrush-thermic/late, with an overall projected reduction in the statewide population of 11%. The primary element influencing association with those habitats is assumed to be the presence of Joshua tree, not blackbrush itself.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss to development, wildfire, and loss of Joshua tree to pinyon-juniper canopy closure. North of the Mojave pinyon-juniper removal may be detrimental.

NEEDS:

Research Needs: Develop a better understanding of species distribution in pinyon-juniper habitats not associated with Joshua tree.

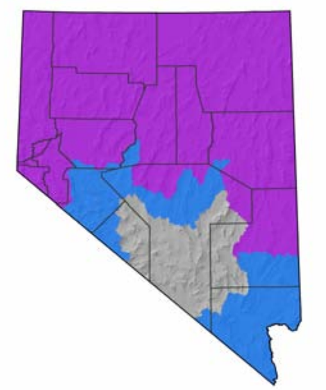
Monitoring and Existing Plans: The NV All Bird Count program captures this species. Covered in the Partners in Flight North American Landbird Conservation Plan.

Approach: Develop fire management strategies that curtail the loss of Joshua tree habitat and Mojave range restoration techniques that can effectively restore Joshua tree to the landscape; develop open space strategies to mitigate impacts of urban/suburban development, and population maintenance strategies to mitigate impacts of pinyon-juniper control outside of the Mojave Desert.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Lower Montane Woodlands and Chaparral.

Short-eared Owl *Asio flammeus*

WAP 20112 species due to significant declining U.S. population trends.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 5,000 (BBS/PIF, moderate); trend in NV is inconclusive, BBS and CBC data indicate a significant decline (North America) since 1966.

DISTRIBUTION: Breeds in northeastern and east-central NV, winter resident throughout state.

GENERAL HABITAT AND LIFE HISTORY:

Breeding habitat includes broad expanses of open land with low vegetation for nesting and foraging and high rodent densities. Habitat types frequently mentioned as suitable include fresh and saltwater marshes, grassy plains, old fields, river valleys, meadows, and open woodland (Dement'ev et al. 1951, Clark 1975, Mikkola 1983, Holt and Melvin 1986). Roosts by day on ground, on low open perch, under low shrub, or in conifer. Nests on ground, generally in slight depression (Terres 1980), often beside or beneath a bush or clump of grass. Many nests are near water but generally are on dry sites. Same nest site may be used in successive years.

Eats mainly rodents (commonly Microtus); also regularly other small mammals, small birds, and insects (Terres 1980, Holt 1993). Forages primarily by flying low, typically into wind, and dropping down onto prey, sometimes after brief hover. Sometimes caches food.

CONSERVATION CHALLENGES:

Preferred habitats are vulnerable to a variety of land use demands including improper grazing of meadows and water withdrawals. Appear to be particularly sensitive to habitat fragmentation and vulnerable to mammalian predation. Prey abundance determines annual distribution and breeding success (Melvin et al. 1989).

NEEDS:

Research Needs: Study breeding bird response to pro-active meadow management strategies, for example, deferred grazing to post-fledging; application of different grazing treatments during the post-fledging season; response to "refugia" (fenced portion of a larger meadow), including minimum effective acreage; responses to different rest-rotation strategies. Conduct additional research on the distributions and habitat requirements of wintering populations.

Monitoring and Existing Plans: Species monitored through the Nevada All Bird Count and covered under the Nevada Partners in Flight program, Partners in Flight North American Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Management for suitable habitat includes maintaining large tracts of open grassland, salt or freshwater marshes, or other appropriate habitat. Restoration or new establishment of grasslands may offer potential habitat. Manage livestock grazing of meadows to allow for suitable nesting sites, including full-rest pastures, deferred grazing until July 15, moveable fenced refugia, etc. Manage a portion of meadow habitat within a project for residual herbaceous vegetation build-up on an annual basis, rotating as appropriate. Retain cured emergent vegetation stands on dry wetland units to facilitate the build-up of rodent populations; burn or remove only when stand structure begins to disintegrate. In addition, care must be taken to allow for adequate build-up of the litter layer that provides habitat for microtine rodents. Microtus populations require adequate cover for several aspects of their ecology (Birney et al. 1976). Maintenance of an adequate prey base is essential since distribution and abundance seems to be tied to prey density (Adair 1892, Lockie 1955, Clark 1975, Melvin et al. 1989).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Marshes, Grasslands and Meadows, Agricultural Lands.

Sierra Nevada Mountain Willow Flycatcher *Empidonax traillii brewsteri*

WAP 2012 species due to declining continental trends and concerns over montane riparian habitat vulnerability.

Agency Status	
NV Natural Heritage	G5T3T4S2B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: NV population size and trend are unknown.

DISTRIBUTION: Occurs in western Nevada, particularly the Sierra Nevadas.

GENERAL HABITAT AND LIFE HISTORY:

Found in shrubby deciduous habitats, especially riparian areas and meadows with shrubby patches dominated by willows or alder. Minimum area requirements and patch dynamics are still largely unknown. Small openings in deciduous shrub habitats or adjacent stream edges increase habitat suitability, and large, contiguous willow patches apparently do not support willow flycatchers at the interior of the patch (USDA Forest Service 1994). In montane meadows in CA, the smallest documented nesting area is a 0.25 ha (0.6 acre) meadow in the Sierra Nevada, but other observers found most nesting territories in meadows >8.0 ha (2 acre) and none in meadows <0.4 ha (1 acre) (USDA Forest Service 1994). In the Sierra Nevada, needs riparian areas and wet meadows at least 0.25 ha (0.6 acre) in size with openings and large, dense patches of deciduous shrubs, and dense foliage at mid-heights (1-2 meters(3-6 ft)); habitat areas of at least 8 ha (19.75 acres) are optimal. Territories contained 5-80 % willow cover (average 44 %), 18-78 % (average 54 %) foliage density in the 0-1 m (0-3 ft) shrub layer, and 45-96 % (average 69 %) foliage density in the 1-2 m (3-6 ft) shrub layer (Sanders and Flett 1989).

CONSERVATION CHALLENGES:

BBS data indicate significant population declines in parts of OR, WA, and CA. NV populations may extend from the Sierra Nevada into lowland riparian habitats along the Carson, Truckee, and Walker Rivers. Vulnerable to invasion of montane and lowland riparian habitats by exotic plants, channel entrenchment, and loss of willow to improper grazing practices.

NEEDS:

Research Needs: So few pairs are thought to exist in the NV portion of the Sierras that focused area searches are likely needed. Genetic studies of willow flycatcher pairs on the Truckee, Carson, and Walker Rivers are needed to determine subspecies distribution. Annual population and productivity monitoring is needed as well as surveys to determine presence/absence, and habitat relationships. Information is needed on landscape relationships, minimum area requirements, and patch dynamics; also the effect of breeding habitat isolation and connectivity. Further study is needed of habitat preferences throughout the species range, particularly in relation to productivity, tolerance of non-native vegetation, relationship to land management activities, and response of flycatchers to habitat restoration. More information is needed on parasitism rates, productivity of parasitized nests, response to parasitism, and activities and habitat that promote the incidence of cowbirds. Effects of pesticides on the species are unknown.

Monitoring and Existing Plans: Monitored in the past by the Forest Service (see USDA Forest Service 2004), but no consistent monitoring effort is known in NV. Low population numbers will require focused area searches. Covered in the Nevada Comprehensive Bird Conservation Plan, Partners in Flight North American Landbird Conservation Plan, and the Humboldt-Toiyabe Forest Plan.

Approach: Riparian and meadow restoration is the primary conservation action. Where cowbirds are affecting population viability, measures to reduce cowbird presence during the breeding season will be needed. Forest Service standards and guidelines for management of montane meadows should be implemented.

WAP HABITAT LINKS: Intermountain Riparian, Wet Meadows, Grasslands and Meadows.

Sooty Grouse *Dendragapus fuliginosus*

WAP 2012 species due to declining continental and western U.S. trends.

Agency Status	
NV Natural Heritage	G5SNR
USFWS	No Status
State Prot	Game Birds NAC 503.045
PIF	Priority Bird Species
Aud	Red List
CCVI	Presumed Stable

TREND: The NV population size and trend are unknown; however, estimated 50% declines in western U.S. since 1960s.

DISTRIBUTION: Occurs in the Carson Range of the Sierras, the Sweetwater Range, and the White Mtns.

GENERAL HABITAT AND LIFE HISTORY:

Primarily a solitary montane species. Coniferous forest, especially fir, mostly in open situations with a mixture of deciduous trees and shrubs (AOU 1983). Spends winter, usually at higher elevation than summer habitat, in conifer forest of various categories of age and tree density; roosts in large conifers with dense foliage. Nests in montane (mixed or deciduous) forest, also in shrubland in some areas. Nests on ground under cover of brush, branches or other vegetation.

In summer feeds on a variety of berries, insects, flowers, and leaves. In the winter feeds mainly on needles and buds of conifers (Douglas-fir often important).

Blue Grouse recently split into two species, Sooty Grouse and Dusky Grouse.

CONSERVATION CHALLENGES:

Vulnerable to loss of chaparral understory in coniferous forest habitats due to exotic plant invasion and indiscriminate fuels management practices.

NEEDS:

Research Needs: Conduct research to better the distribution of Sooty and Dusky Grouse in Nevada. Research the importance of old-growth conifer forests to this species as in California (Jim Bland); determine responses and tolerance thresholds to invasion of exotic plants into chaparral understories of Sierra Nevada coniferous forest habitats.

Monitoring and Existing Plans: Not currently monitored but as a game bird, NDOW has developed detailed conservation and management priorities for this species. In addition, NDOW does a wing collection effort each year; however, the sample size is small. Covered in the Partners in Flight Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain healthy, diverse coniferous forest habitats with a mosaic of densely stocked stands with closed canopies for roosting and wintering and open, thinly stocked stands with well-developed chaparral understories for nesting and brooding.

WAP HABITAT LINKS: Aspen, Sierra Coniferous Forests and Woodlands, Intermountain Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral, Alpine and Tundra.

Southwestern Willow Flycatcher — *Empidonax traillii extimus*

WAP 2012 species due to its federally endangered status and because its preferred habitat is sensitive and vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5T1T2S1B
USFWS	LE
BLM-NV	Sensitive
USFS-R4	Endangered
State Prot	Endangered Birds NAC 503.050.2
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 90 (NDOW, moderate); trend is assumed stable.

DISTRIBUTION: Restricted to willow or tamarisk habitats in saturated soils in southern Nevada along the Colorado River and its tributaries.

GENERAL HABITAT AND LIFE HISTORY:

Restricted to riparian habitat in Mojave river systems and tributaries. Nests primarily in swampy thickets in willow or tamarisk 4-7 m or more in height. Habitat patches as small as 0.5 ha can support one or two nesting pairs (see USFWS 1995). Nests in fork or on horizontal limb of small tree, shrub, or vine, at height of 0.6-6.4 m (mean usually about 2-3 m) (Harris 1991), with dense vegetation above and around the nest.

Eats mainly insects caught in flight, sometimes gleans insects from foliage; occasionally eats berries. In breeding range, forages within and occasionally above dense riparian vegetation.

CONSERVATION CHALLENGES:

All occurrences can be considered threatened as they are highly susceptible to predation and brood parasitism. Vulnerable to activities that result in floodplain desertification, habitat alteration due to fire, and Brown-headed Cowbird brood parasitism.

NEEDS:

Research Needs: Continue current monitoring and research efforts. Responses and tolerance thresholds to exotic plant invasion and desertification of native floodplain habitats are needed.

Monitoring and Existing Plans: Considerable survey effort expended in recent years by USFWS, BLM, NPS, FS, NDOW, and other entities in connection with land management activities and endangered species conservation. Final Recovery Plan Southwestern Willow Flycatcher (Southwestern Willow Flycatcher Recovery Team Technical Subgroup 2002), Partners in Flight North American Landbird Conservation Plan, Clark County MSHCP Covered Species, Lower Colorado River MSCP Covered Species, Nevada Comprehensive Bird Conservation Plan.

Approach: Protect all known nesting habitat from disturbances, degradation, and conversion. Restore lost or degraded riparian habitat to a willow-dominated condition. Phase restoration projects to avoid removing large amounts of tamarisk before creating suitable replacement habitat (GBBO 2010). Continue intensive monitoring efforts to track population trends in NV.

WAP HABITAT LINKS: Warm Desert Riparian.

Tricolored Blackbird *Agelaius tricolor*

2012 WAP species because there is only one isolated breeding population in the state and there are concerns about federal listing within its core range.

Agency Status	
NV Natural Heritage	G2G3S1B
USFWS	No Status
PIF	Priority Bird Species
IUCN	Endangered
Aud	Red List
CCVI	Presumed Stable

TREND: The NV population estimate is 100 (PIF, moderate); trend assumed stable.

DISTRIBUTION: Limited to Carson Valley. This single reliable breeding colony is migratory, and is peripheral and disjunct from the main population (CA) of Tricolored Blackbirds, which it rejoins in the winter months. This colony usually breeds in a small privately-owned marsh in Douglas County, in close proximity to both Red-winged and Yellow-headed Blackbirds (Ammon and Woods, 2008).

GENERAL HABITAT AND LIFE HISTORY:

Highly gregarious. Roosts and forages in flocks; range widely to > 15 km from nesting colony (Beedy and Hamilton 1999). Breeds in fresh-water marshes of cattails, tule, bulrushes and sedges (AOU 1983). Historically strongly tied to emergent marshes; in recent decades much nesting has shifted to non-native vegetation.

Insects (e.g., beetles, caterpillars) comprise a large portion of the diet. Feeds on seeds and grain in fall and winter.

CONSERVATION CHALLENGES:

Considered vulnerable because of its highly localized distribution and small population occurring on private land that is not managed specifically for wildlife. Vulnerable to natural or anthropogenic disturbance.

NEEDS:

Research Needs: Basic local comparative ecology should be completed relative to what is known about CA birds.

Monitoring and Existing Plans: A focused monitoring effort for Tri-colored Blackbirds began in 2005 (www.tricoloredsurvey.com). Covered in the Partners in Flight North American Landbird Conservation Plan and Nevada Comprehensive Bird Conservation Plan.

Approach: Attempt to secure some form of protection for the known and possible breeding marshes, through the IBA program or other mechanisms. Encourage landowners at and around the known persistent colony to continue their stewardship. Develop private lands conservation program for Carson Valley in cooperation with local conservation district, including wetlands management funding support through government assistance programs. Develop and maintain alternative suitable habitat on managed properties (e.g., The Nature Conservancy's River Fork Ranch).

WAP HABITAT LINKS: Marshes, Lakes and Reservoirs, Agricultural Lands.

Virginia's Warbler *Oreothlypis virginiae*

WAP 2012 species due to slight declining trends rangewide and concerns over riparian habitat stability, particularly in the context of climate change.

Agency Status	
NV Natural Heritage	G5S4B
USFWS	No Status
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 8,200 (NBC, moderate); trend in NV unknown, apparently stable range-wide.

DISTRIBUTION: Breeding range scattered throughout NV, excluding northwest roughly south of Interstate 80 from Reno to Battle Mountain, then extends north to Idaho state line across to Utah state line.

GENERAL HABITAT AND LIFE HISTORY:

Breeds in arid montane woodlands, oak thickets, pinyon-juniper, coniferous scrub, chaparral (AOU 1998). Brushy steep mountain slopes within or near dry coniferous woodlands (Dunn and Garrett 1997). Will inhabit ravines or rocky slopes with dense scrub oaks or mountain mahogany. Also found along mountain streams in cottonwood and willow habitat at 1,800-2,800 m (5,900 to 9,186 ft), usually associated with pinyon-juniper or mountain mahogany uplands. Nests on ground among dead leaves, or in small depression under cover of brush, tufts of grass, or similar cover. Well-concealed by vegetation, bark, grasses, roots, mosses, and lichens; rim of nest may be level with surface (Bent 1953; Griscom and Sprunt 1957). In very dry years, may select wetter sites in drainage bottoms, but may also be more vulnerable to higher nest predation rates (Martin and Olson 1999).

Insectivorous. Forages on ground in thick brush and flies into air to catch insects; both parents seen carrying caterpillars to young (Terres 1980). Will probe, glean, hover, and hang upside down to catch insects (Martin and Olson, in press).

Migrates later than other warblers, arriving in NV in late April/May. Possibly disperse to lower elevations after breeding and before migration. Fall migration from mid-August, occur in mixed species flocks after breeding season (Fischer 1978, cited in Martin and Olsen 1999). Virginia Warbler is projected to decrease by 9% over the next 50 years based on the climate change model (TNC 2011). Estimated densities are relatively low for this species in all habitat types it is known to use during nesting, and the main losses projected under the climate model occur in aspen mixed-conifer/late and blackbrush-mesic/late, while birds are expected to be gained in aspen mixed-conifer (GBBO 2011).

CONSERVATION CHALLENGES:

Listed on the Partners in Flight WatchList as a species of moderate conservation priority chiefly due to limited knowledge of the species biology (Muehter 1998). May be vulnerable due to its narrow geographic distribution on breeding and wintering ranges and lack of large populations in breeding range (Reed 1992).Habitat threats may include unsustainable grazing by livestock or wild horses and burros, fire, exotic plant invasion and desertification of montane riparian habitats, and residential development, especially in southern Nevada.

NEEDS:

Research Needs: Improved population estimate and distribution in NV is needed. Little is known about natural history and ecology. Need quantified information on habitat, microhabitat, and landscape relationships, including possible importance of mountain mahogany and proximity to water, and the possible use of aspen habitat in southern Nevada.

Monitoring and Existing Plans: NV All Bird Count program. Partners in Flight North American Landbird Conservation Plan and the Nevada Comprehensive Bird Conservation Plan.

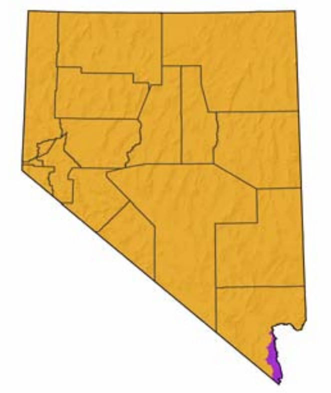
WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forest, Intermountain Riparian.

Approach: Patchy distribution, uncertainty about population trends, and the likelihood that specific habitat requirements exist that are not yet quantified, form the basis for conservation concern for this species (GBBO 2010). Address research needs listed above. Restore and maintain riparian habitats in healthy, multi-storied condition. Develop conservation strategy for mountain-mahogany and other montane brush types.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forest, Intermountain Riparian.

Western Burrowing Owl *Athene cunicularia hypugaea*

WAP 2012 species due to (non-significant) declining population trends in the west and localized urban development (i.e., Clark Co.).



Agency Status	
NV Natural Heritage	G4T4S3B
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 3,000 (NBC, moderate); trend is inconclusive.

DISTRIBUTION: Found statewide.

GENERAL HABITAT AND LIFE HISTORY:

Optimum habitat typified by short vegetation and presence of fresh small mammal burrows (Zarn 1974). Found in open grasslands, sagebrush, and sagebrush-steppe, sometimes in open areas such as vacant lots near human habitation (e.g., campuses, airports, golf courses, perimeter of agricultural fields, banks of irrigation canals). Spends much time on the ground or on low perches such as fence posts or dirt mounds. Nests and roosts in abandoned burrow dug by mammal (especially ground squirrel in NV (Citellus spp.), badger (Taxidea taxus), fox, tortoise. Rarely excavates own burrow, preferring to enlarge or modify existing burrow. Uses satellite burrows around nest burrows, moving chicks at 10-14 days presumably to reduce risk of predation. Pattern of burrow use influenced by availability, soil, dynamics of [small mammal] population, and other owls (Desmond and Savidge 1998).

Feeds primarily on large insects (especially in warmer months) and rodents; sometimes eats birds and amphibians. Catches prey in flight or drops to ground.

In Nevada, Burrowing Owls occur sporadically in valley bottoms, sometimes in loose colonies (Hall et al. 2003, Paige and Ritter 1999).

CONSERVATION CHALLENGES:

In NV, vulnerable to habitat loss and fragmentation primarily due to urban land conversion and habitat degradation from control and extermination of colonial burrowing mammals (Dundas and Jensen 1995, Haug et al. 1993, Rodriguez Estrella et al. 1998). Also vulnerable to vehicle collisions, predators, persecution, harassment by dogs, collapse of burrows, and food availability (Erickson 1987, Haug and Didiuk 1991, James and Espie 1997, see also Wedgwood 1979, Wellicome and Haug 1995).

NEEDS:

Research Needs: A standardized survey effort specific to burrowing owls is recommended to determine population status and trend. Further investigations are also needed regarding use of habitat enhancements (e.g., artificial burrows and perches); responses to relocation and reintroduction; and impact of predators on nest success (Millsap et al. 1997).

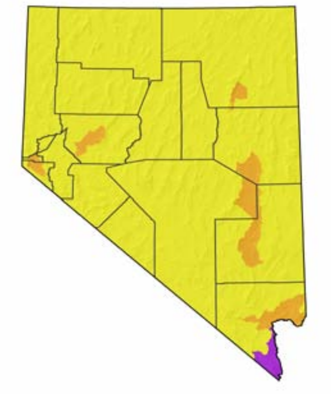
Monitoring and Existing Plans: Some recorded monitoring completed during BBS and NBC efforts, but frequency of sampling is too low to provide adequate data on a NV-wide scale. Covered in the Clark County MSHCP (Evaluation Species), and the Nevada Comprehensive Bird Conservation Plan.

Approach: Establish and implement effective monitoring programs and determine population status and trend in Nevada. Manage known colony locations to maintain short vegetation, healthy populations of burrowing animals, and healthy owl prey populations. Limit disturbance around active nest burrows and use artificial burrows as mitigation for habitat loss to urban development (GBBO 2010).

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Grasslands and Meadows, Sand Dunes and Badlands, Developed Landscapes.

Western Least Bittern *Ixobrychus exilis hesperis*

WAP 2012 species because it occurs in low densities in restricted habitats and its population status is unknown.



Agency Status	
NV Natural Heritage	G5T3T4S2B
USFWS	No Status
CCVI	Presumed Stable

TREND: Population size and trend in NV are unknown.

DISTRIBUTION: Small, widespread populations throughout NV. Historic evidence of breeding at Carson Lake; probably breeds in southern NV as well.

GENERAL HABITAT AND LIFE HISTORY:

Habitat consists of tall emergent vegetation in marshes, primarily freshwater. Prefers marshes with scattered bushes or other woody growth. Forages in shallow water or along banks. Heavy growths of cattail, bulrush, wild rice, burreed, water smartweed, and reeds are favored feeding sites (Brewer et al. 1991).

Eats small fishes, amphibians, leeches, slugs, snails, crustaceans, insects, and occasionally small mammals (Palmer 1962); possibly the eggs and young of marsh-nesting blackbirds.

Usually solitary, extremely secretive and difficult to survey.

CONSERVATION CHALLENGES:

Appears to be exceedingly rare in NV, but this could be an artifact of lack of survey efforts for this species. Vulnerable to loss or degradation of marshes due to water diversions, declines in water quality, or development.

NEEDS:

Research Needs: Improve population status and trend; conduct studies to better determine specific preferred habitat parameters.

Monitoring and Existing Plans: Secretive marsh bird protocols are being incorporated into NV waterbird surveys. Covered in the Intermountain West Waterbird Conservation Plan, Clark County MSHCP Watch List Species, Lower Colorado River MSCP Covered Species, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Implement statewide surveys based on secretive marsh bird protocols (Conway 2004). Maintain vigorous emergent marsh habitats in fresh water with diverse macroinvertebrate and small fish populations.

WAP HABITAT LINKS: Marshes.

Western Sandpiper *Calidris mauri*

WAP 2012 species due to Nevada's stewardship responsibility for this species during migration.

Agency Status	
NV Natural Heritage	G5S5M
USFWS	No Status
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV migration population estimate is 12,000 with peaks up to 50,000; trend is cyclic but appears to be declining across their range.

DISTRIBUTION: Migratory across Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Nonbreeding habitat includes mudflats, beaches, shores of lakes and ponds, shallow lagoons, artificial salt ponds, and flooded fields; various coastal habitats with flat or gently sloping muddy, sandy, or gravelly shores; less often inland at pond edges, rain pools, wet fields (Stiles and Skutch 1989).

Feeds primarily on aquatic insects; also eats mollusks, worms, and crustaceans. Runs along edge of water snatching up prey from wet mud.

CONSERVATION CHALLENGES:

Loss or degradation of flat, muddy open water shorelines due to water diversions, declines in water quality, or development (GBBO 2010).

NEEDS:

Research Needs: Improved global population estimate and trend; determine relative importance of ephemeral wetlands and playas as migration habitat (GBBO 2010).

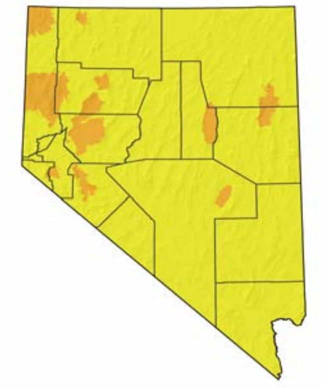
Monitoring and Existing Plans: Monitored through NDOW shorebird surveys, NWR and WMA counts, and Aquatic Bird Count. Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain flooded conditions at very shallow water depths with attendant wet mud flats in important habitat during migration periods, prevent mid-summer dewatering and encourage seasonal runoff into ephemeral wetlands and playas (GBBO 2010).

WAP HABITAT LINKS: Desert Playas and Ephemeral Pools, Marshes.

Western Snowy Plover *Charadrius nivosus nivosus*

WAP 2012 species because it is moderately vulnerable to climate change and federally listed as threatened.



Agency Status	
NV Natural Heritage	G3T3S3B
USFWS	No Status
BLM-NV	Sensitive
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Moderately Vulnerable

TREND: The NV population estimate is 350-1,000 (PIF, moderate). Trend cyclic, apparently declining.

DISTRIBUTION: In NV, breeds in Churchill, Clark, Elko, Eureka, Humboldt, Lyon, Mineral, Nye, Pershing, Washoe, and White Pine counties. Migrant throughout the state. Distribution is based upon water availability on alkali playas throughout the state.

GENERAL HABITAT AND LIFE HISTORY:

Often seen on alkali playas near standing pools of shallow water. During times of drought they rely heavily on artesian wells and springs that spill water onto the dry playas. Nests generally on recently exposed alkaline flats (Paton and Edwards 1992).

Eats insects, small crustaceans, and other minute invertebrates (Terres 1980). Picks food items from substrate, probes in sand or mud in or near shallow water, sometimes uses foot to stir up prey in shallow water.

Predation by gulls, common raven, red fox, skunk, raccoon, and/or coyote may result in a high rate of clutch loss in some areas (Page et al. 1985; Paton and Edwards 1991, 1992). Usually solitary or in twos during non-breeding, though may form pre-migratory flocks of hundreds in some areas.

CONSERVATION CHALLENGES:

Vulnerable to habitat loss from development and as a result of dewatering of playas or springs during the breeding season due to water diversions, drought, or climate change.

NEEDS:

Research Needs: Continue periodic species-specific (or playa-centric) inventory efforts to clarify long-term population trends. Investigate the extent to which climate change will impact runoff events to playas and model impacts to availability of nesting habitat.

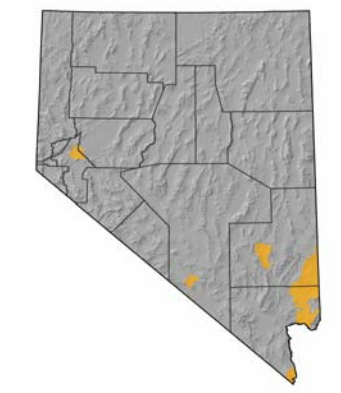
Monitoring and Existing Plans: The Nevada Aquatic Bird Count should capture this species. Covered in the U.S. Shorebird Conservation Plan, Intermountain West Regional Shorebird Plan, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Protect or restore season water inflow for playas through the end of the breeding season (approximately 1 July). Manage or restrict playa activities to protect the integrity of the clay soil pan and maximize water retention (GBBO 2010).

WAP HABITAT LINKS: Desert Playas and Ephemeral Pools, Lakes and Reservoirs, Marshes.

Western Yellow-billed Cuckoo *Coccyzus americanus occidentalis*

WAP 2012 species because it is moderately vulnerable to climate change, it is highly linked to specific characteristics of riparian habitat, a sensitive habitat type, and it is a federal candidate for listing.



Agency Status	
NV Natural Heritage	G5T3QS1B
USFWS	C
BLM-NV	Sensitive
State Prot	Sensitive Birds NAC 503.050.3
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The NV population estimate is 10-20 (NDOW, moderate); trend is unknown and occurrences are highly variable between years.

DISTRIBUTION: Currently known from only a few localities in southern NV, but historically, occurred statewide, in large, contiguous riparian corridors; last detected on the Carson River above the Lahontan Reservoir in 1996.

GENERAL HABITAT AND LIFE HISTORY:

Riparian obligate species which requires dense cottonwood-willow forested tracts. In some areas, birds required 17+ ha (42 acres), including a minimum of 3+ ha (7.5) of closed-canopy, broad-leaved forest. Nests are placed in willows, but cottonwoods are used extensively for foraging.

Primarily eats large insects. Consumes many smooth, hairy, or spiny caterpillars, especially tent caterpillars which are available in abundance when present. Eats a variety of moths and crickets, and occasionally beetles, flies, spiders, frogs, and small lizards. Most frequently forages by gleaning insects from leaves and stems, usually while perched, but occasionally while hovering.

Territorial status unclear; needs more study. May establish breeding territory that covers many acres in some areas. However, in other areas no evidence of breeding or foraging territories found. Solitary during breeding season; observed alone or in breeding pairs. Associates in larger numbers during migration. Major predators include falcons (adults), jays, grackles, snakes, and some small mammals (eggs and nestlings).

CONSERVATION CHALLENGES:

Deciduous riparian forests have declined throughout the west as a result of water diversions, dams and river flow management, stream channelization and stabilization, unsustainable livestock grazing, groundwater pumping, woodcutting, and invasion of non-native vegetation such as tamarisk (USFWS 2003, Hunter et al. 1988, Ehrlich et al. 1992). Remaining riparian habitat is largely in a degraded condition (Katibah 1984). Also considered very vulnerable to deforestation on its wintering grounds (Morton 1992). Very sensitive to habitat fragmentation; may require intact woodlands of at least 40 ha to breed in CA, and prefers woodlands greater than 80 ha (Laymon and Halterman 1989).

NEEDS:

Research Needs: Continue intensive single-species monitoring, including nesting documentation; habitat use and preferences still mostly unknown specific to Nevada..

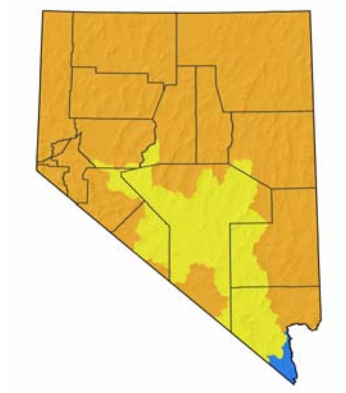
Monitoring and Existing Plans: Species is intensively monitored in southern NV by BOR, NDOW, USFWS. Covered Species in the Clark County MSHCP, Lower Colorado River MSCP Covered Species, and the Nevada Comprehensive Bird Conservation Plan.

Approach: Restore and enhance complex riparian habitats with mature cottonwood overstory and woody willow mid-story. Design and implement a coordinated fire management strategy that protects occupied remnants of cuckoo habitat.

WAP HABITAT LINKS: Intermountain Riparian.

White-faced Ibis *Plegadis chihi*

WAP 2012 species due to breeding stewardship responsibility and wetland habitat concerns, particularly in the context of climate change.



Agency Status	
NV Natural Heritage	G5S3B
USFWS	No Status
PIF	Priority Bird Species
CCVI	Presumed Stable

TREND: The NV population estimate is 5,000-6,000 with high annual variability (USFWS/expert, moderate); trend is currently declining from peaks in 1990s.

DISTRIBUTION: Breeds in western and northeastern NV, migrant throughout the state.

GENERAL HABITAT AND LIFE HISTORY:

Primary habitat is marshes, swamps, ponds and rivers, mostly in freshwater habitats (AOU 1983). Nests in marshes; in low trees, on the ground in bulrushes or reeds, or on a floating mat.

Typically feeds on crayfish, frogs, fishes, insects, newts, earthworms, crustaceans, etc. (Terres 1980). In Nevada forages predominantly in flooded agricultural fields for earthworms.

CONSERVATION CHALLENGES:

Vulnerable to habitat alteration, dewatering of nest colonies during nesting, and pesticide contamination. Breeders in NV were still being contaminated with DDE-DDT in Mexican wintering areas as late as the 1990s (Henny and Herron 1989).

NEEDS:

Research Needs: Improved Great Basin subpopulation estimate and trend; connectivity of major Great Basin breeding locations (Lahontan Valley, NV; Great Salt Lake, UT; Malheur NWR, OR; Klamath NWR, CA) .

Monitoring and Existing Plans: Monitored through the NV Aquatic Bird Count and NDOW aerial colonial waterbird surveys. Covered in the Intermountain West Waterbird Conservation Plan, White-faced Ibis Status and Management Guidelines: Great Basin Population, and the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Continue monitoring program as a means of better documenting breeding distribution, numbers and trends in NV. Provide consistently flooded nesting habitat through the breeding season to ensure chick fledging.

WAP HABITAT LINKS: Marshes, Wet Meadow, Agricultural Lands, Lakes and Reservoirs.

White-headed Woodpecker *Picoides albolarvatus*

WAP 2012 species due its restricted range in Nevada, specific habitat preferences, and climate change vulnerability of Jeffrey Pine habitat.

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
USFS-R4	Sensitive
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population size estimate is 840 (NBC, moderate); trend in NV is unknown. Region-wide BBS trend data indicate stable to increasing.

DISTRIBUTION: Restricted to the Carson Range of far western Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Montane coniferous forest, primarily pine and fir (AOU 1983). Important habitat components are an abundance of mature pines of species that produce large cones and abundant large seeds, relatively open canopy of 50-70 % closure, and numerous snags and stumps for nest cavities (Garrett et al. 1996). In the Sierra Nevada, CA, inhabits mixed conifer forests of ponderosa pine and sugar pine, white fir, red fir, Douglas-fir, and black oak. Also occurs locally on dry east-slope Jeffrey pine forests and high-elevation lodgepole pine and western white pine forests; prefers mature and older stands with open canopies, less than 69 % canopy cover (Milne and Hejl 1989, Garrett et al. 1996). In some areas, may descend to lower elevations for winter. May wander within suitable coniferous forest habitat during non-breeding season (Garrett et al. 1996).

Pine seeds are a major part of the species diet, especially in fall and winter. Birds cling to sides and bottoms of cones as they chip cones open to obtain seeds (Ligon 1973). Also probe, glean, and pry off loose bark for spiders, beetles, ants, fly larvae, and other insects (Ligon, 1973, Terres 1980, Spahr et al. 1991). May also catch some flying insects.

Excavates a nest cavity usually in a dead tree trunk or stump, 1-8 m (3-26 ft) above ground. Nests excavated in larger snags, usually more than 58 cm (1.9 ft) dbh. In central and southern Sierra Nevada, most nests are in dead pine or fir, usually broken-topped snags, nest cavities average of 3 m (10 ft) above ground (Milne and Hejl 1989). The GBBO (2011) analysis of bird population responses to projected effects of climate change suggested losses of White-headed Woodpecker pairs at lower elevations if Jeffrey pine habitat converted to chaparral or pinyon-juniper. Net loss was not quantified.

CONSERVATION CHALLENGES:

Vulnerable to habitat degradation. The preferred large-diameter trees are also prized for their commercial value. Logging practices (in NV, snag removal and salvage logging) and forest fragmentation have contributed to local declines (Garrett et al. 1996). Fire suppression over the past 50 years has altered fire regimes so that ponderosa pine forests are no longer maintained by frequent natural fire, but are being replaced by Douglas-fir and true fir developing in the understory, now susceptible to stand-replacing fires.

NEEDS:

Research Needs: Further research is needed regarding habitat relationships throughout the range such as area sensitivity, effects of fragmentation and landscape composition. An inventory of suitable habitat is needed, as is an assessment of approaches and feasibility of restoring late-seral forest characteristics. Much of its biology and ecology remains unstudied.

Monitoring and Existing Plans: Captured by the NV All Bird Count. Covered under the Humboldt-Toiyabe Forest Plan, LTBMU Forest Plan, Partners in Flight North American Landbird Conservation Plan, and the Nevada Comprehensive Bird Conservation Plan.

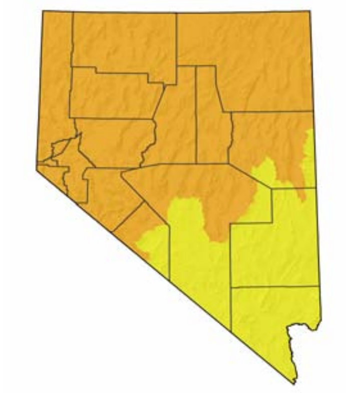
WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands.

Approach: Maintain stands of mature and old-growth coniferous forest of appropriate tree species composition with large-diameter snags. Implement active management to restore appropriate fire regimes, restore late-seral stands over time, maintain continuous blocks of habitat, and protect snags from cutting (especially fire-wood cutting). Maintain large-diameter snags for nesting and roosting and live trees for snag recruitment and foraging and nesting habitat. Small diameter (<30 cm dbh) incense cedar should also be retained as an important foraging tree, especially for winter use (Morrison et al. 1985, Morrison and With 1987).

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands.

Wilson's Phalarope *Phalaropus tricolor*

WAP 2012 species because it is moderately vulnerable to climate change, its preferred breeding habitat is sensitive and vulnerable to degradation, and Nevada also has migration stewardship responsibility.



Agency Status	
NV Natural Heritage	G5S2S3B,S4M
USFWS	No Status
PIF	Priority Bird Species
CCVI	Moderately Vulnerable

TREND: The NV population size estimate is 3,000 during breeding and 12,000 during staging and migration with wide annual migratory population fluctuations (NDOW/expert, moderate). Trend is unknown but probably declining.

DISTRIBUTION: Breed fairly widely across northern Nevada; migrate statewide.

GENERAL HABITAT AND LIFE HISTORY:

Found in shallow freshwater and saline ponds, marshes and wet meadows (AOU 1998). Nests on the ground in wet meadows, grassy marshes, and along edges of shallow inland waters. The nest is a well-concealed scrape, lined with grass. Uses both fresh and alkali wetlands with three characteristics: open water, emergent vegetation, and open shoreline (Saunders 1914, Hohn 1967, Stewart 1975, Prescott et al. 1995, Naugle 1997). Non-breeding season found on lake shores, mudflats, salt marshes, freshwater marshes, alkaline ponds; rarely along seacoasts; stages on salt lakes (Colwell and Jehl 1994, AOU 1998). Also at sewage ponds.

Eats insects (larvae and adults), especially mosquitoes and crane flies. On salt flats may feed on alkali flies, brine shrimps, seeds of aquatic plants. Feeds as it walks along muddy shores, wades in shallow water, or swims and whirls.

CONSERVATION CHALLENGES:

Vulnerable to loss or degradation of marshes, ponds, and lakes due to water diversions, declines in water quality, development, or climate change (GBBO 2010).

NEEDS:

Research Needs: Improved breeding population estimate; research conservation needs of breeding birds and the relative importance of ephemeral wetlands such as flooded playas during spring migration; response and tolerance thresholds to exotic plant invasion of suitable nesting habitat (riparian meadows).

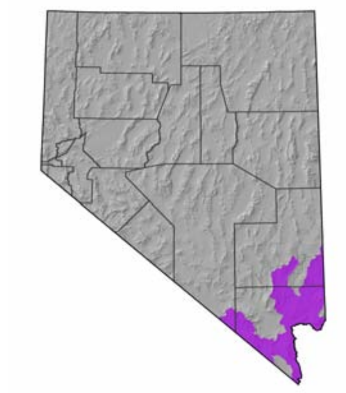
Monitoring and Existing Plans: Monitored through NDOW shorebird counts, WMA and NWR counts and the Aquatic Bird Count. Covered in the Nevada Comprehensive Bird Conservation Plan.

Approach: Maintain critical wetland areas across Nevada that are important for staging Wilson's phalaropes; maintain native haymeadow in unmowed (ungrazed) condition through breeding season (approx. July 1).

WAP HABITAT LINKS: Lakes and Reservoirs, Marshes, Desert Playas and Ephemeral Pools.

Yuma Clapper Rail *Rallus longirostris yumanensis*

WAP 2012 species due to its federal listing status as endangered.



Agency Status	
NV Natural Heritage	G5T3S1
USFWS	LE
BLM-NV	Sensitive
State Prot	Endangered Birds NAC 503.050.2
PIF	Priority Bird Species
Aud	Yellow List
CCVI	Presumed Stable

TREND: The NV population estimate is 20-40 (expert, high); trend is unknown.

DISTRIBUTION: Resident along the Colorado River and its tributaries, southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Generally in freshwater and alkali marshes dominated by stands of emergent vegetation interspersed with areas of open water and drier, upland benches (Biosystems Analysis 1989). Nests probably on dry hummocks or in small shrubs among dense cattails or bulrushes along the water edges with stable water levels (Ehrlich et al. 1992).

Eats crayfish, small fishes, clams, isopods, and various insects. Probably probes in mud or sand in or near shallow water or picks items off substrate (Ehrlich et al. 1992).

CONSERVATION CHALLENGES:

Loss or degradation of marshes due to water diversions, decline in water quality, and development are the main threats to the species.

NEEDS:

Research Needs: Implement secretive marshbird survey protocols in potential habitat and conduct studies to determine whether seasonal movements occur.

Monitoring and Existing Plans: Focused surveys have been conducted in southern NV under contract by the Southern NV Water Authority, and by Bureau of Reclamation biologists. Secretive marsh bird surveys within the Nevada Aquatic Bird Count. Covered in the Yuma Clapper Rail Recovery Plan, Lower Colorado River MSCP, and the Nevada Comprehensive Bird Conservation Plan. Watch List Species in the Clark County MSHCP.

Approach: Implement conservation strategies outlined in the Yuma Clapper Rail Recovery Plan.

WAP HABITAT LINKS: Marshes.

Allen's big-eared bat *Idionycteris phyllotis*

WAP 2012 species because of significant regional population declines as well as patchy distribution and low population numbers in Nevada.

Agency Status	
NV Natural Heritage	G4S1
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Presumed Stable

TREND: Although trend is not well documented, there is much anecdotal information that this species is severely declining. In the Spring Mountains where they were previously captured and recorded, this species has not been recently observed. In other parts of their range outside the state, this species is declining and numbers of individuals are probably much less than previously thought.

DISTRIBUTION: Restricted to Clark County although there is speculation this species could occur in some areas of Nye and Lincoln counties.

GENERAL HABITAT AND LIFE HISTORY:

Inhabits mountainous areas and uses a variety of habitats including Mojave Desert scrub, coniferous forests, and riparian woodlands. Roosts in rocks, cliffs, snags, and mines throughout its range but known roosts in Nevada consist only of snags and abandoned mines. Maternity colonies are generally found in mines. In the winter, they are thought to move from higher elevations to lower elevations but this is poorly understood.

Food items include a variety of insects but diet predominantly consists of moths, probably gleaned from vegetation or captured in flight. At least in some areas, this species demonstrates high roost fidelity with individuals flying 70-100 km roundtrip nightly between foraging grounds and the day roost (Brown and Berry 2004).

Winter ecology is poorly understood, but they presumably hibernate in mines and caves and are capable of periodic winter activity. Allen's big-eared bats form groups during the maternity season in hollow trees or abandoned mines. During this time, bats are particularly sensitive to disturbance and have been known to abandon sites, sometimes leaving their young behind.

CONSERVATION CHALLENGES:

Maternity roosts appear to be a critical limiting factor. Mine closure or renewed use could impact populations. Improper forest management can eliminate tree roosts, particularly large snags that this species relies on. Alteration of natural springs can also create serious impacts. Bats are very vulnerable to disturbance during hibernation and if disturbed often enough, can deplete their stored fat and starve to death.

NEEDS:

Research Needs: Current population status, delineating roosting preferences and requirements, and describing foraging and reproductive behavior are needed. Monitoring of known populations and surveying for new occurrences are also critical.

Monitoring and Existing Plans: Allen's big-eared bats are discussed in the Nevada Bat Conservation Plan (2006). This species is also a Watch List species under the Clark County MSHCP.

Approach: Any sites used as roosts should be protected from disturbance and damage. Identify and map winter, maternity, bachelor, lekking, and night roosts. Coordinate protection measures such as installation of bat gates or access restrictions with appropriate land management agencies. Coordinate mine inventories for significant bat colonies with mine closure programs of various agencies, including BLM, Forest Service, and NV Division of Minerals. Forest management should include maintenance of a variety of seral stages, including old growth and snags. This species should be monitored in mines and caves for evidence of white-nose syndrome.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Cliffs and Canyons, Caves and Mines.

Allen's chipmunk *Neotamias senex*

WAP 2012 species because it has a very limited and patchy distribution within the state.

Agency Status	
NV Natural Heritage	G5S2S3
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: NW US from north-central OR through the northern mountains of CA (between the Klamath and Eel rivers, east to the Warner Range at the CA-NV border, south to Yosemite, crossing the NV border east of Lake Tahoe); occurs above 1,500 m in the central Sierra Nevada (Gannon and Forbes 1995).

GENERAL HABITAT AND LIFE HISTORY:

Allen's chipmunk, sometimes referred to as the Shadow chipmunk, is a large mountain chipmunk that generally prefers mature coniferous forests and chaparral slopes dominated by ponderosa pine, Jeffrey pine, sugar pine, black oak, Douglas fir, white fir, red fir, incense cedar, and mountain hemlock. The shrub layer includes buckbrush, manzanita, blackberry, and chinquapin. A study in the Sierra Nevada found that Allen's chipmunk was most abundant in red fir, than in mixed conifers (Coppeto et al., 2006).

They feed on the fruits of forest trees and shrubs, ground-level herbs, grasses, fungi, and occasionally insects. Allen's chipmunk forages on log-strewn forest floors and in adjacent chaparral as well as in trees.

Nests are located among logs or brush and in hollow trees. During the winter, it undergoes deep hibernation periods, with little or no active periods.

CONSERVATION CHALLENGES:

Range restricted and in NV limited to a region north of Reno and in the Sierra Nevada.

NEEDS:

Research Needs: This species was incidentally observed during focused trapping studies conducted by NDOW for the northern flying squirrel. The status and distribution, habitat preferences, and responses to climate change need to be determined.

Monitoring and Existing Plans: This species is not currently monitored and does not occur within any other existing plans.

Approach: Conduct surveys and monitor known occurrences to determine status, trend, range, and habitat preferences of the species within Nevada. A project proposal to conduct focused studies for Allen's chipmunk is currently being prepared by NDOW and State Lands Nevada Tahoe Resource Team (NTRT).

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Sierra Coniferous Forests and Woodlands.

American marten *Martes americana*

WAP 2012 species because of limited and patchy occurrences and its preference for old-growth forests.

Agency Status	
NV Natural Heritage	G5S2S3
USFWS	No Status
State Prot	Fur-bearing Mammal NAC 503.025
CCVI	Presumed Stable

TREND: Rare and secretive; trend unknown.

DISTRIBUTION: Primarily found in the Sierra Nevada although there is some recent evidence for occurrence in the Jarbidge Mountains.

GENERAL HABITAT AND LIFE HISTORY:

In Nevada, martens occur in coniferous forest and may use rocky alpine areas. Use of habitat is related to food availability, especially in winters with deep snow. When inactive, they occupy holes in dead or live trees or stumps, abandoned squirrel nests, conifer crowns, rock piles, burrows, or snow cavities. In winter, much of a marten's activity occurs under the snow, often in coarse woody debris. Martens are active year-round.

Mostly carnivorous, but will supplement its diet with berries in the summer. Voles and mice are a major staple for martens. They hunt mainly on the ground but are fast enough to catch squirrels and birds in the forest canopy. Foraging activity is mostly nocturnal in winter, diurnal in summer in the Sierra Nevada, and apparently synchronous with activity of prey (Zielinski et al. 1983).

Except during breeding, martens are basically solitary and territorial. Activity may peak at dusk and dawn in summer while they are have been observed by day in winter. Male and female home ranges differ in size; males occupy a home range of about one square mile while females may only have a home range size of a quarter of a square mile. Young may disperse 40 km (25 miles) or more. Martens are relatively long-lived, with a recorded lifespan of approximately 15 years.

CONSERVATION CHALLENGES:

This species has a limited distribution in Nevada and is primarily linked to mature forests with complex understory; however, has also been observed in second growth forest. Logging and fuels reduction projects without allowances for dead/down woody material degrade habitat suitability. Threatened by a potential increase in the frequency and intensity of wildfires in old-growth forest areas and by small fragmented habitats.

NEEDS:

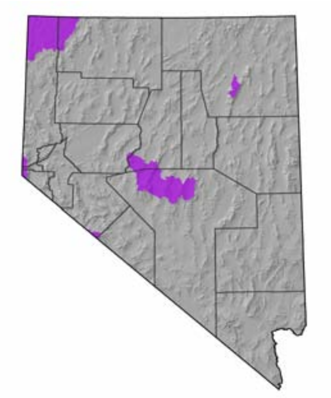
Research Needs: Status, distribution, and population viability in NV, including verification of possible population in the Jarbidge Mountains, needs investigation.

Monitoring and Existing Plans: Included in the Sierra Nevada Forest Plan Amendment as an old forest associated species and carnivore of special concern (USFS 2004). A northern flying squirrel study currently being conducted by NDOW will aid in a better understanding of the American marten's potential occupancy within the Tahoe basin since it preys upon the northern flying squirrel and snowshoe hare.

Approach: Determine population trends in Nevada and monitor known populations. Conduct systematic surveys within the Jarbidge mountains to determine presence/absence. Protect vulnerable populations as appropriate. Implement Forest Service standards and guidelines for forest furbearer management in suitable habitat.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Aspen.

American pika *Ochotona princeps*



WAP 2012 species because it is moderately vulnerable to climate change, it requires a very specific thermal regime, its populations are isolated and fragmented throughout the state, and there are climate change concerns for its preferred alpine habitat.

Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Moderately Vulnerable

TREND: In isolated areas, it appears that pikas are experiencing local extirpations, while at others they may be more stable. At least seven new populations were discovered by NDOW during 2009-2010 surveys within and around Sheldon NWR in the northwest corner of the state.

DISTRIBUTION: Occurs in isolated populations from the rimrocks of extreme northwestern Nevada to the alpine talus formations of the Sierra Nevada, several central mountain ranges (e.g., Toiyabe Range), east to the Ruby Mountains and East Humboldt Range in Elko County.

GENERAL HABITAT AND LIFE HISTORY:

Restricted to rocky talus slopes, or rimrocks with deep fissures and crevices, primarily the talus-meadow interface. The lower talus slopes at this interface (within the talus matrix below the surface rocks) has been shown to provide the coolest warm-season temperatures. They also maintain greater winter snow cover, insulating haypiles and reducing exposure to cold outside air (Millar 2011). Also occupy areas above the treeline up to limit of vegetation and lower elevations in rocky areas within forests or near lakes. Does not dig burrows but may enlarge den or nest site under rock. Recent surveys in CA and NV found pika at elevations between 1,827 and 3,887 meters (5,994-12,752 feet) (Millar and Westfall 2010).

Feeds primarily on grasses and sedges; also eats some flowering plants and shoots of woody vegetation.

Pikas are active year-round. In late summer and fall, they harvest and store food (forbs, grasses, marmot pellets) for winter consumption; stored food may be most important when winter is unusually harsh or long. They are relatively inactive on warm days; near their lower elevation limit they may be inactive at midday in hot weather (Smith and Weston 1990). Pikas are individually territorial, relatively long-lived (some can live up to 6 years of age), and vacant territories are scarce. Hence, an important factor in juvenile survival is their ability to find and colonize a vacant territory.

CONSERVATION CHALLENGES:

Possible direct anthropogenic influences on pikas include use of talus rock for road construction, recreational shooting, and unsustainable grazing by non-native herbivores along talus margins. Millar (2011) suggests that grazing at the base of talus communities (i.e. forefields) possibly removes preferred, high value forage and drives individual pikas upslope to poorer quality habitat, therby impacting population health. Climate change is most likely to impact pikas through conversion of alpine vegetative communities to sagebrush or mixed conifer and the increase of temperatures at the highest elevations that may exceed a pika's thermoregulatory tolerances. Climate change appears more likely to affect populations in 5-20 years and beyond. Populations in marginal habitat have already significantly declined although the causes are unknown. On February 5, 2010 the USFWS determined that the American pika does not meet the criteria for protection under the ESA. The findng indicated that although potentially vulnerable to the impacts of climate change in portions of its range, the best available scientific information indicates the species will be able to survive despite higher temperatures in a majority of its range and is not in danger of extinction in the foreseeable future.

NEEDS:

Research Needs: Statewide species specific inventory; additional surveys need to be conducted to determine current distribution, both latitudinal and elevational. Local extinctions are hypolthesized to be linked to large scale climatic fluctuations, but further evaluation is needed. Further investigation in metapopulation dynamics needs to be determined in order to fully understand the conservation challenges and opportunities for this species.

WAP HABITAT LINKS: Alpine and Tundra, Cliffs and Canyons, Grasslands and Meadows.

Monitoring and Existing Plans: NDOW species specific inventory survey effort in progress, along with temperature monitoring of occupied and unoccupied talus habitats throughout the state. At least seven new populations were discovered by NDOW during 2009-2010 surveys within and around Sheldon NWR in the northwest corner of the state. NDOW also confirmed pikas from Marlette Lake to the Mount Rose wilderness in the Carson Range and Lake Tahoe Basin in 2011. This species is not included in any other existing plans.

Approach: Determine population viability, demographic analysis, and confirm trend. Identify suitable unoccupied habitat and evaluate potential for reintroduction. Identify actual effects of livestock grazing on pika where grazing occurs adjacent to occupied talus habitat and adjust strategies if necessary.

WAP HABITAT LINKS: Alpine and Tundra, Cliffs and Canyons, Grasslands and Meadows.

American water shrew *Sorex palustris*

WAP 2012 species because it is moderately vulnerable to climate change and its preferred habitat is sensitive and vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Extreme western, and central through northeastern NV.

GENERAL HABITAT AND LIFE HISTORY:

Found in the vicinity of streams or other bodies of water. Water shrews require sufficient shelter such as dense vegetative cover, logs, rocks, crevices, etc. These areas provide overhead protection and high humidity. They use both terrestrial and aquatic habitat to find food and escape predators.

Primarily dependent upon aquatic insects; also eats various other invertebrates. May take small vertebrates (fishes, amphibians) when available. Hunts under and on top of water. May even be seen running across the water surface. Terrestrial food items include insects, snails, earthworms, fungi, and green plant material.

Water shrews, with their high metabolic rates, need to consume approximately their weight in food every day (Conaway 1952, Sorenson 1962). In the wild they seem unable to store significant body fat and can die of starvation within a few hours. When a surplus of food is available, it is often horded, the shrew sometimes defecating on it to keep other shrews away. Two major activity periods reported: sunset to four hours after and just before sunrise (van Zyll de Jong 1983). Generally active throughout the day and in every season, but secretive and seldom seen. Their lifespan is approximately 18 months.

CONSERVATION CHALLENGES:

Habitat has been fragmented since the retreat of the last glaciers making isolated populations vulnerable to extirpation. Water shrews are particularly vulnerable to the destruction of their aquatic habitats through pollution and drainage (Churchfield 1992). Montane stream water quality and the quality of associated riparian vegetation is the primary concern in Nevada.

NEEDS:

Research Needs: Research is needed on geographic variation in habitat requirements and on dispersion pattern and dispersal. The minimum population size needed to maintain genetic viability in a fragmented habitat should be investigated.

Monitoring and Existing Plans: This species is not currently monitored and is not within any other existing plans.

Approach: The water shrew is a boreal species, requires high quality water, preferably mountain streams, and abundant cover such as rocks, logs, or overhanging streambank. Suitable management consists primarily of maintaining these conditions. Guidelines should be developed for activities with potentially adverse impacts. Buffer strips should be maintained along potential water shrew habitat. Pesticide use that might impact aquatic/riparian invertebrate populations should be avoided whenever possible. In some cases it may be desirable to reintroduce shrews from nearby populations to restored habitat, although the difficulty and expense of such an action may be prohibitive. Occupied habitat should be mapped and a low impact monitoring program should be maintained.

WAP HABITAT LINKS: Intermountain Riparian, Sierra Coniferous Forest and Woodland.

bighorn sheep *Ovis canadensis*

WAP 2012 species because it is moderately vulnerable to climate change; its patchily distributed, small, and isolated populations; as well as habitat vulnerability and disease concerns.

Agency Status	
NV Natural Heritage	G4S4
USFWS	No Status
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Game Mammal NAC 503.020
CCVI	Moderately Vulnerable

TREND: Trend is stable in some areas, declining in others primarily due to lung disease.

DISTRIBUTION: Occurs in suitable habitat in mountain ranges throughout the state.

GENERAL HABITAT AND LIFE HISTORY:

Bighorn sheep occur in mesic to xeric, alpine to desert grasslands or shrub-steppe in mountains, foothills, or river canyons (Shackleton et al. 1999, Krausman et al. 1999). Many of these grasslands are fire-maintained (Geist 1971, Erickson 1972). Escape terrain (cliffs, talus slopes, etc.) is an important feature. Dense forests and chaparral that restrict vision are avoided (Shackleton et al. 1999, Krausman et al. 1999). In the north, bighorn are not usually dependent on free-standing water, getting water instead from succulent vegetation in the summer and snow or ice in the winter (Van Dyke 1978). However, in the south, bighorn may be dependent on access to free water during summer (Turner 1979, Turner and Weaver 1980, Seegmiller and Ohmart 1981) and access to mineral licks may be important in spring (Shackleton et al. 1999, Krausman et al. 1999).

Bighorn sheep diets are diverse and variable. They are primarily grazers of grass and forbs, but diet can also include significant amounts of shrubs (Miller and Gaud 1989, Krausman et al. 1999, Shackleton et al. 1999). Their diet changes seasonally. During the day, feeding alternates with rest-rumination periods. There are peak feeding times in the early morning and at dusk. During the winter, bighorns increase the length of time spent actively feeding.

Populations other than those in low deserts typically migrate between an alpine or montane summer range and a lower elevation winter range (Shackleton et al. 1999).

CONSERVATION CHALLENGES:

Nevada has a high stewardship responsibility for desert bighorn. Small, isolated populations are at increased risk from predation and disease. Carrying capacity for bighorn can be reduced through unsustainable grazing by other ungulates. Disease transmission is believed to occur primarily via contact with domestic sheep. Lungworm infections weaken bighorns to the point of vulnerability to respiratory infection by opportunistic bacteria.

NEEDS:

Research Needs: Response and tolerance thresholds to exotic plant invasion into native habitats.

Monitoring and Existing Plans: NDOW annual big game population monitoring, NDOW Bighorn Sheep Management Plan (2001), Clark County MSHCP watch list species (ssp. nelsoni only).

Approach: Evaluate opportunities to expand the range of bighorn sheep through active water development and a trapping and transplanting program. Maintain migration corridors to enhance metapopulation dynamics and continue the active implementation of the NDOW Bighorn Sheep Management Plan (2001).

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forest, Alpine and Tundra, Grasslands and Meadows, Cliffs and Canyons.

Botta's pocket gopher *Thomomys bottae*

WAP 2012 species because of taxonomic isolates that are vulnerable due to habitat degradation and conversion. This species is also moderately vulnerable to climate change.

Agency Status	
NV Natural Heritage	G5SH
USFWS	No Status
BLM-NV	Sensitive
CCVI	Moderately Vulnerable

TREND: Status and trend are unknown for this species, particularly for isolated and potentially taxonomically distinct populations.

DISTRIBUTION: Can be found throughout the state in appropriate habitat. Two subspecies of priority interest are isolated to two valleys, T. b. abstrusus in Fish Spring valley (also known as Little Fish Lake Valley) in Nye County, and T. b. curtatus in Big Smoky Valley. A third isolate occurs near Eastgate (T. b. lucrificus).

GENERAL HABITAT AND LIFE HISTORY:

Pocket gophers are associated with a wide range of vegetation types, and a wide variety of soils from soft sands to friable loams and hard clays. They are residents of open habitats and meadows, where soils are deep enough to maintain permanent burrow systems. They can be highly variable in their morphological characteristics and generally live in small, local populations. This has led to a large number of isolated subspecies, of which the taxonomy is still not well understood.

Eats roots, bulbs, tubers, and other vegetable matter. Pocket gophers mainly feed underground, pulling plants into burrows by roots. Pocket gophers are the most efficiently adapted of any living North American rodent for utilizing underground roots. They probably store food in burrows. Common predators of pocket gophers include raptors, owls, snakes and carnivorous mammals.

Pocket gophers are intermittently active day and night throughout the year. They are fossorial and are rarely found above ground. When they are above ground, they are very vulnerable to predation, particularly by owls. They can efficiently burrow through snow to reach above-ground vegetation and, in some areas, this may be a dispersal mechanism. Dirt ridges from in tunnels in the snow can be evidence of pocket gophers in an area. Pocket gophers are characteristically of low mobility (often they are referred to as sedentary), philopatric, and with small effective population sizes (Daly and Patton 1990). Pocket gophers are ecologically important as prey items and in influencing soils, microtopography, habitat heterogeneity, diversity of plant species, and primary productivity (Huntly and Inouye 1988). Juvenile dispersal is largely aboveground and at night. Juvenile dispersal distance averages 400 meters with maximum distances of less than one kilometer recorded.

CONSERVATION CHALLENGES:

Pocket gophers are at risk because they occur in Isolated populations that are vulnerable to extirpation and are threatened by habitat degradation and conversion, particularly from climate change.

NEEDS:

Research Needs: Continue to study distribution, status, and trend. It is particularly important for this species to conduct genetic work to determine subspecific taxa within isolated areas. Records for this species are generally historic, and Hall (1946) delineates multiple, isolated subspecies, of which status and trend are unknown. Basic life history information is needed, as is an understanding of the species ecology so that an informed management plan can be developed.

Monitoring and Existing Plans: Limited surveys have recently been conducted by NDOW with some genetic work, but much remains to be done.

WAP HABITAT LINKS: Intermountain Riparian, Wet Meadow, Grasslands and Meadows.

Approach: Known, isolated subspecific populations need to be systematically inventoried, especially for the Fish Spring pocket gopher (T. b. abstrusus), the San Antonio pocket gopher (T. b. curtatus), and a potentially new isolate near Eastgate (T. b. lucrificus). Genetic work needs to be conducted to delineate subspecies and various populations. Once genetic work has been completed, rare and isolated populations should receive conservation planning attention. Possible conservation strategies include easements and private lands conservation funding assistance.

WAP HABITAT LINKS: Intermountain Riparian, Wet Meadow, Grasslands and Meadows.

California leaf-nosed bat *Macrotus californicus*

WAP 2012 species because it has a very restricted range within Nevada, has specific roost requirements that limit its distribution, and its preferred foraging habitat is vulnerable to conversion and/or degradation, especially with respect to climate change. This species is never very abundant and there are regional conservation concerns.

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
USFS-R5	Sensitive
State Prot	Sensitive Mammal NAC 503.030.3
CCVI	Presumed Stable

TREND: Status and trend unknown although some historic roosts have been lost due to closures of abandoned mines or destruction by vandals.

DISTRIBUTION: California leaf-nosed bats are only known from Clark County which seems to represent the northern-most limit of this species global range.

GENERAL HABITAT AND LIFE HISTORY:

California leaf-nosed bats day roost in caves and mines. Night roosting can occur in a variety of places, including buildings, cellars, porches, bridges, rock shelters, and mines. Because this species does not hibernate or migrate long distances, they will move to specific, warm winter roosts, which in Nevada are generally geothermally heated abandoned mines. Mines used as winter roosts must have internal temperatures greater than 29°C (84°F). This species can form large colonies of 600 or more individuals.

Food items include grasshoppers, cicadas, moths, butterflies, dragonflies, beetles, and caterpillars. Foraging generally commences 1 hour after sunset and occurs close to vegetation or the ground where prey items are gleaned from the surface.

Usually found roosting in groups (sometimes up to 600 bats) but individuals do not cluster. Maximum life expectancy is estimated at more than 10 years. Reproductive rates are generally low, with females having a single young per year. As with most bats, this species is very sensitive to disturbance and harassment.

CONSERVATION CHALLENGES:

This species is behaviorally sensitive to roost disturbance and limited in its distribution by specific winter roosting requirements (warm mines), making roost protection critical to the conservation of this species. Other threats include mine reclamation and renewed mining, and loss or conversion of desert wash riparian vegetation where this species seems to concentrate its foraging. Historic inundation of roosts and foraging areas by the formation of Lakes Mead and Mojave have contributed to the limited distribution and population size observed today.

NEEDS:

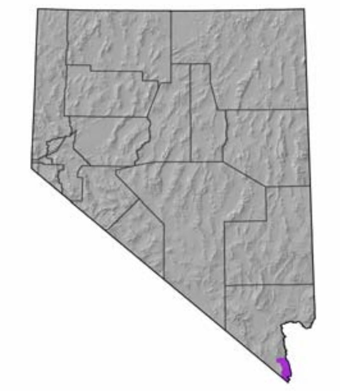
Research Needs: This species is thought to be most limited by its winter roosting requirements because California leaf-nosed bats cannot tolerate lowered body temperatures like other bats and requires warm and stable roosts. Research efforts should focus on surveys for new roosts, especially winter roosts, documenting roosting requirements, foraging habits, and delineating the status of this species.

Monitoring and Existing Plans: The California leaf-nosed bat is discussed in the Nevada Bat Conservation Plan and it is a Watch List species in the Clark County MSHCP.

Approach: Key winter, maternity, bachelor, lekking, and/or night roost sites should be identified, mapped, and monitored. Critical roosting sites in mines and caves should be conserved and protected by either installing appropriate bat gates, education of the public, road/trail closures or restrictions, and/or access restrictions. All mines that are proposed to be permanently closed should be properly evaluated for bat habitat prior to closure and should never be closed during the maternity and hibernation seasons. This species should be monitored for evidence of white-nose syndrome.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Cliffs and Canyons, Caves and Mines, Developed Landscapes.

WAP 2012 species because of its limited population within the state and its apparently low population as compared with historic numbers. There are also regional population concerns for this species.



Agency Status	
NV Natural Heritage	G5S1B
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Apparently declining. Older large guano piles indicate that historically the only known NV population was much larger than the current population. Many maternity colonies of this species along the Colorado River have been disappearing due to habitat conversion indicating a downward trend for this species. Western populations in CA, NV, and AZ seem to be declining and more at risk than elsewhere in the species' range.

DISTRIBUTION: Only one known population (roost) near Lake Mead NRA in Clark County.

GENERAL HABITAT AND LIFE HISTORY:

As their name suggests, cave myotis day roost in caves and mines, although they are occasionally found in buildings in some areas. They are crevice dwellers, preferring cracks, pockets, and holes in the ceilings of mines and caves. Cave myotis show high roost fidelity from year to year and can tolerate summer roost temperatures as high as 37°C. This species night roosts in caves, mines, buildings, culverts, and bridges, generally close to the entrance or near open areas, and has been repeatedly found in swallow nests, particularly in the non-reproductive season. Maternity colonies can be very large (greater than ten thousand individuals), although males generally roost in groups of less than 100. This species hibernates, although it can periodically arouse to forage or drink. Winter ecology in Nevada is poorly understood.

Foraging for moths and beetles occurs in open areas near the edge or over vegetation. Unlike other bat species, cave myotis are never found more than a few miles from some type of water source. Cave myotis emerge from their roost well before dark and have a relatively short bout of foraging (approximately an hour) before night roosting. It is unclear if there is a defined second early morning foraging period as there is in some other species.

CONSERVATION CHALLENGES:

Very large roosts sizes, high sensitivity to disturbance and large-scale habitat conversion (at least along the Colorado River portion of its range) may be causes for the apparent decline of the species. In Nevada, guano deposits indicate this one known colony was much larger than it is currently; reasons for decline are unknown. The large guano pile also suggests that this was once a maternity colony whereas now it is strictly composed of bachelor males.

NEEDS:

Research Needs: The one colony of this species in the state needs to be monitored and surveyed for any evidence of reproduction. The current status of the species needs to be delineated. Despite the occurrence of numerous abandoned mines along the lower Colorado River, this species is found in only a few areas. Information is needed on roosting and foraging requirements, as well as use and acceptance of bat gates. The status of this species needs to be documented.

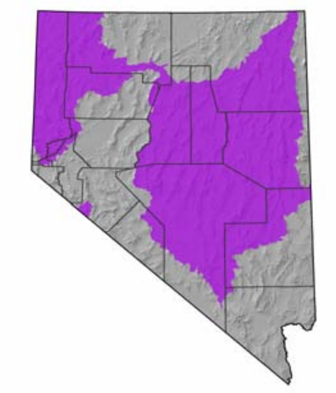
Monitoring and Existing Plans: Cave myotis are discussed in the Nevada Bat Conservation Plan (2006) and this species is listed as a Watch List species under the Clark County MSHCP.

Approach: Monitor species occurrences and protect the only known roosting site of the species with bat-friendly closures. Conduct additional surveys to search for new populations of the species including abandoned mines slated for closure. Delineate population status and trend. Cave myotis should be monitored for evidence of white-nose syndrome.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Cliffs and Canyon, Caves and Mines.

dark kangaroo mouse *Microdipodops megacephalus*

WAP 2012 species because it is highly vulnerable to climate change, has uncertain population size and status, and Nevada has a large stewardship responsibility for the species as a whole.



Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Highly Vulnerable

TREND: Declining trend but population numbers are unknown. M. megacephalus is among the least abundant of the nocturnal desert rodents and it now appears that they are even less abundant than they were 30 years ago (Hafner and Upham, 2011). Populations in the northern portion of the range are severely declining, many of which are locally extinct or in serious decline due to loss of habitat (Hafner and Upham, 2011).

DISTRIBUTION: Range centered on NV, extending to southeast OR, northeastern and central-eastern CA, southwestern ID, and west-central UT.

GENERAL HABITAT AND LIFE HISTORY:

Inhabits stabilized dunes and other sandy soils in valley bottoms and alluvial fans dominated by big sagebrush (Artemisia tridentata), rabbitbrush (Chrysothamnus spp.), and horsebrush (Tetradymia spp.). Also occurs on fine gravelly soils where M. pallidus also occurs (Wilson & Ruff 1999). M. megacephalus typically occurs in sandy habitats below the elevation where pinyon-juniper occur and above those habitats where greasewood and saltbush predominate (Hafner, 2011). Although restricted to sand, it displays a broad tolerance for varying amounts of gravel.

Seeds are the primary food source although it will also eat some insects. It does not appear to use free-standing water and probably gets moisture from its food sources. It is believed to store food in seed caches within their burrow system (O'Farrell and Blaustein 1974).

Dark kangaroo mice are nocturnal rodents and show seasonally active periods from March through October. Individuals are underground in burrows when inactive and during hibernation in the winter. Peak nocturnal activity occurs in first 2 hours after sunset. Moonlight and ambient temperature influence activity (O'Farrell and Blaustein 1974), with individuals less active during brighter moon phases or temperatures above or below their optimum thermal zone. Predators include owls, foxes, and badgers. In west-central NV, mean yearly circular home range for males was 6,613 m2 (1.6 acres); for female, 3,932 m2 (0.97 acres) (O'Farrell and Blaustein 1974). Climate change concerns center on the predicted increase in fires and invasive grasses that will accelerate habitat loss. Hafner and Upham (2011) did not find evidence of a northward or an elevationally upward distributional change, which is consistent with patterns reported in other xeric-adapted mammals (Rowe et al. 2010).

CONSERVATION CHALLENGES:

Populations have always been patchy and rare across the landscape and it appears that habitat loss is increasing fragmentation and amplifying isolation effects. Populations in the northern portion of its range seem to be declining much more rapidly than populations in the southern part of its range. In general, populations in their lower ecological range are facing ever-increasing environmental threats and habitat loss from fires, invasive plants, and unsustainable livestock grazing, whereas populations in their upper ecological range are threatened by loss of sagebrush habitat due to encroachment from pinyon-juniper (Hafner and Upham 2011).

NEEDS:

Research Needs: Additional field work and monitoring are needed in northern portions of this species range to better understand the status and temporal stability of isolated populations (Hafner 2011). Also needed are response and tolerance thresholds to invasive grasses, weeds, and pinyon-juniper encroachment. In general, monitoring of the species as a whole is necessary to ascertain population status and overall trend.

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Grasslands and Meadows, Sand Dunes and Badlands, Desert Playas and Ephemeral Pools.

Monitoring and Existing Plans: Recent genetic work has been completed by Hafner and Upham (2011) and as part of this study, many known populations revisited. NDOW has focused on this species in recent years and reports of its occurrences are documented in statewide small mammal trapping projects, including the Wildlife Action Plan Performance Indicators Monitoring Project.

Approach: Monitoring and management of known populations is critical to understanding and maintaining current distributions of this rare species, especially in northern portions of its range. Presence/absence surveys should be conducted in areas with suitable habitat.

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Grasslands and Meadows, Sand Dunes and Badlands, Desert Playas and Ephemeral Pools.

desert kangaroo rat — *Dipodomys deserti*

WAP 2012 species because it has a patchy distribution and is restricted to limited habitat that is vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5S2S3
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is stable to declining.

DISTRIBUTION: Occurs in dunes and sandy areas from northwestern NV, through the southwestern part of the state, and southern NV.

GENERAL HABITAT AND LIFE HISTORY:

Desert kangaroo rats are found in low deserts, in sandy soil with sparse vegetation or in alkali sinks. They are found in shadscale scrub and creosote bush scrub, in the Lower and Upper Sonoran life zones. They are mostly restricted to deposits of deep wind-blown sand (sometimes including deposits formed as result of human activity) although there is one record from gravelly soil in an area of Arizona. They nest in burrows dug in mounds, usually under vegetation.

Feeds on seeds and green vegetation (Burt and Grossenheider 1964). Desert kangaroo rats store large quantities of seeds underground. They may also occasionally feed opportunistically on moths, beetles, and other insects (Rust 1989).

Burrow sites are usually under vegetation on wind-driven sand dunes. They may form widely spaced colonies comprising 6-12 large burrows. The maximum recorded density of desert kangaroo rats in one area was about 3/ha (3/2.5 acres). They are basically solitary except female with young (Best et al. 1989). Colonies may die out following successive years of drought.

CONSERVATION CHALLENGES:

Vulnerable to OHV use and development adjacent to dune habitats.

NEEDS:

Research Needs: A better understanding of population connectivity and potential effects of fragmentation is needed. As a component of this effort, genetic analysis of known populations to determine degree of population isolation could be helpful. Basic distribution, trend, and status information is also needed. Documentation of the northern range limit of this species in NV is needed.

Monitoring and Existing Plans: This species is not currently monitored. It is a Clark County MSHCP High Priority Evaluation Species.

Approach: Delineate status and trend for the species and monitor accordingly. Presence/absence surveys should be conducted in appropriate habitat to generate a better understanding of where the species occurs. Potential impacts from recreation and development should be evaluated as to the effects on the species as a whole and appropriate protective actions should be undertaken.

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Sand Dunes and Badlands, Grasslands and Meadows.

desert pocket mouse *Chaetodipus penicillatus*

WAP 2012 species because it has a limited distribution in Nevada, is moderately vulnerable to climate change, and its preferred habitat is sensitive and vulnerable to degradation, especially with respect to climate change.

Agency Status	
NV Natural Heritage	G5S1S2
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is unstable; known populations have become very disjunct and there are many threats to its habitat.

DISTRIBUTION: Known populations are restricted to the Muddy and Virgin River systems; however SW ReGAP has predicted a wider distribution within Clark County.

GENERAL HABITAT AND LIFE HISTORY:

The desert pocket mouse occurs on sparsely vegetated sandy desert floors. They have a strong affinity for areas with creosote bush and saltbush and seem to prefer level terrain with fine, sandy or light gravely soils. They have been found on rock-free bottomland soils along rivers and streams (Hall 1946, Ingles 1965).

Feeds on seeds, including those of mesquite and creosote bush, and stores food in their underground burrow system. Foraging occurs under large bushes and in dense grasses, although this is not a requirement.

Desert pocket mice are nocturnal. They probably are not as active in winter as in summer and may become torpid for several days. They sleep and rear young in underground burrows. Home range size for adults and juveniles of both sexes probably is about 0.2 ha (½ acre). The annual population turnover is probably almost complete.

CONSERVATION CHALLENGES:

Threatened by habitat conversion and fragmentation, especially in consideration of changing climates. Restricted to a small area that is increasingly threatened by development, water diversions, non-native species, and recreation pressures.

NEEDS:

Research Needs: Status and trend for the species needs to be better understood. Our current understanding of the locations of populations is restricted compared to potential habitat modeled in the SW ReGAP analysis. Population connectivity and viability analysis are needed.

Monitoring and Existing Plans: Some surveys are periodically conducted. The desert pocket mouse is a High Priority Evaluation Species in the Clark County MSHCP.

Approach: Conduct surveys in areas predicted to have populations by SW ReGAP to better understand the range and trend of this species. Based on connectivity and viability analysis, protect vulnerable populations as appropriate. Monitor the species to delineate trend.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian.

fringed myotis — *Myotis thysanodes*

WAP 2012 species because it has a patchy distribution across the landscape and is never very abundant; trends and population viability are uncertain and this species could be vulnerable to white-nose syndrome.

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Increase Likely

TREND: Trend is unknown, but this species is considered rare and not commonly captured during surveys.

DISTRIBUTION: Found throughout central and southern Nevada in appropriate habitat, although it probably occurs in northern Nevada as well. Although widely distributed in Nevada, it is considered rare.

GENERAL HABITAT AND LIFE HISTORY:

Fringed myotis have been found day and night roosting in mines, caves, trees, and buildings. They are found in a wide range of habitats from low desert scrub to high elevation coniferous forests. This species hibernates in mines and caves, but is capable of periodic winter activity. Maternity colonies of females and their young can number into the hundreds whereas males often roost singly or in small groups. Both sexes hibernate together.

Foraging occurs in and among vegetation, with some gleaning activity. In some areas, there is evidence that fringed myotis use forest edges as well as over the forest canopy for foraging. Fringed myotis may fly moderate distances (13 km, one-way) to suitable foraging grounds.

CONSERVATION CHALLENGES:

Fringed myotis are especially sensitive to human presence. They are threatened by recreational caving, mine closures, renewed mining, timber harvest, indiscriminate pest control, and bridge replacements and building demolition that do not consider presence and use patterns. Bats are very vulnerable to disturbance during hibernation and if disturbed often enough, can deplete their stored fat and starve to death. Although widely distributed this species is rare and never abundant. If white-nose syndrome spreads to the west, this species could be negatively affected.

NEEDS:

Research Needs: Research studies should focus on current population status, delineating roosting preferences and requirements, and describing foraging and reproductive behavior. Presence/absence surveys are needed to establish its range and population size.

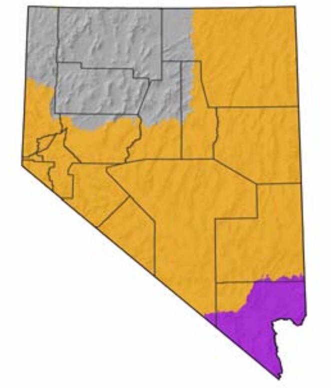
Monitoring and Existing Plans: Fringed myotis are addressed in the Revised Nevada Bat Conservation Plan (2006).

Approach: Key hibernation, maternity, bachelor, staging, lekking, and night roost sites should be identified, mapped, and monitored. Critical roosting sites in mines and caves should be conserved and protected by either installing appropriate bat gates, education of the public, road and trail closures or restrictions, and access restrictions. All mines that are proposed to be permanently closed should be evaluated for bat habitat prior to closure and should not be closed during the maternity and hibernation seasons. Determine species use of pinyon-juniper woodlands. Timber harvest projects, recreation expansion, road expansion, and other woodland activities should be evaluated as to their effects on forest-dwelling bats. Monitor this species for evidence of white-nose syndrome.

WAP HABITAT LINKS: Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Aspen, Lower Montane Woodlands and Chaparral, Cliffs and Canyons, Caves and Mines, Developed Landscapes.

hoary bat *Lasiurus cinereus*

WAP 2012 species because it has an uncertain trend and population status and is very vulnerable to population declines due to alternative energy development.



Agency Status	
NV Natural Heritage	G5S3N
USFWS	No Status
BLM-NV	Sensitive
CCVI	Increase Likely

TREND: Status and trend of species is unknown. Rigorous scientific study of this species is lacking as it can be difficult to capture and monitor.

DISTRIBUTION: Although widely distributed across the state where appropriate forested or riparian habitat is available, populations are patchy and mostly known from the capture of single animals while foraging. Roosting locations are not well known.

GENERAL HABITAT AND LIFE HISTORY:

Hoary bats are a tree-roosting species, found primarily in forested upland habitats such as pinyon-juniper and conifers, as well as in gallery forest riparian zones (e.g., in cottonwoods along the Colorado river drainage). Current Nevada records indicate this species is distributed between 570-2,520,m. Hoary bats day roost in trees 3-12 m above ground and are protected by good leaf cover, but open below to facilitate flying in/out of the roost. They are basically solitary, except for mother-young association; however, during migration, groups of up to hundreds of individuals may form. Some mother-young groups will often change roosts whereas others do not; movements generally are less than 100 m from the previous roost. It is generally assumed that this species migrates from the state during winter, but wintering habits are not confirmed. Elsewhere hibernating individuals have been found on tree trunks, in a tree cavity, in a squirrel's nest, and in a clump of Spanish moss.

Food items include a variety of insects but moths, dragonflies, and beetles feature prominently. Foraging is generally high altitude and occurs over the tree canopy. In the open, rapid descending arcs are exhibited. Also, hoary bats will follow watercourses for foraging and drinking. They are capable of foraging over long distances, up to 40 km (25 miles) from its roost (Altenbach et. al. 2002).

CONSERVATION CHALLENGES:

Impacts from wind farms and alternative energy development along with loss of roosting habitat due to timber harvest, fire, and other forest issues are the primary concerns for this species. Hoary bats are being killed by wind turbines more than any other bat species, although dead silver-haired and free-tailed bats are also often reported. Although it is still unclear exactly how wind turbines induce mortality, it has been proposed that bats are dying from barotrauma, the result of a rapid drop in pressure near moving blades. Mortality is seasonal and coincides with migration periods. As alternative energy continues to be developed, this could contribute significantly to a declining trend in this species.

NEEDS:

Research Needs: Survey work is needed to establish population sizes, range and status for this species. Research is lacking in the basic ecology, distribution, seasonal movement patterns and habitat requirements of the hoary bat. Population impacts from mortality at wind farms needs to be researched and addressed.

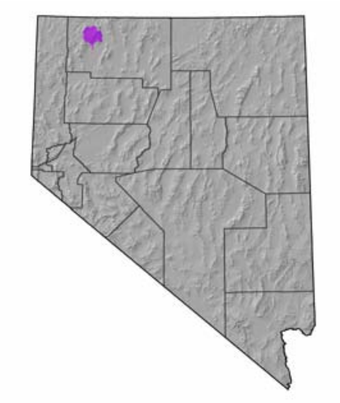
Monitoring and Existing Plans: Hoary bats are addressed in the Nevada Bat Conservation Plan (2006).

Approach: Monitor and survey species to determine impacts of alternative energy development on Nevada populations. Basic survey work for key roosting and foraging sites needs investigation. Determine trend and distribution for this species and monitor for evidence of white-nose syndrome.

WAP HABITAT LINKS: Intermountain Riparian, Warm Desert Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands.

Humboldt yellow-pine chipmunk *Neotamias amoenus celeris*

WAP 2012 species because it is a disjunct, isolated endemic that is restricted to a single mountain range and is moderately vulnerable to climate change.



Agency Status	
NV Natural Heritage	G5T2S2
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Restricted to the Pine Forest Range in Northern Humboldt County, NV.

GENERAL HABITAT AND LIFE HISTORY:

The Humboldt yellow-pine chipmunk is an isolated remnant forest subspecies left by the retreat of pine forest northward with glacial icemelt at the end of the Pleistocene. They generally occur in brushy areas interspersed with herbaceous vegetation and open conifer stands; shrubs typically present include snowberry, chinquapin, mountain mahogany, bitterbrush, currant, and ceanothus (Sutton 1992). They are found among logs, brush, and rocky outcrops, as well as in brushy areas between subalpine forest and alpine tundra, and sometimes in alpine areas themselves.

Diet consists of seeds, fruits, green foliage, flowers, roots, buds, bulbs, tubers, fungi, and small animals. Caches food in burrows and in scattered pits dug into the soil surface. Humboldt yellow-pine chipmunks forage in open areas where trees and bushes are widely spaced and where half-rotten logs, stumps, or rocks are adjacent to food plants.

This chipmunk digs burrows 0.17-.53 m (7-21 inches) deep. Their home range is a few acres, parts of which may be used seasonally (Sutton 1992). Competitive interactions with other chipmunk species may limit habitat use. They intermittently hibernate from late fall through early spring, with frequent periods of activity. During these active periods, they eat stored seeds rather than using built up body fat reserves to last through the winter. Chipmunks may become lethargic during cold summer weather (Banfield 1974, Sutton 1992).

CONSERVATION CHALLENGES:

Isolated endemic subspecies occurring on one mountain range. Could be vulnerable to any activities or changes in climate that would decrease or decimate the limber/whitebark pine forest of the Pine Forest Range.

NEEDS:

Research Needs: Design and implement specific trapping grids to determine distribution. Genetic work is needed to clarify the taxonomic status of this subspecies. Population status and trend, in addition to habitat requirements of the species should be researched.

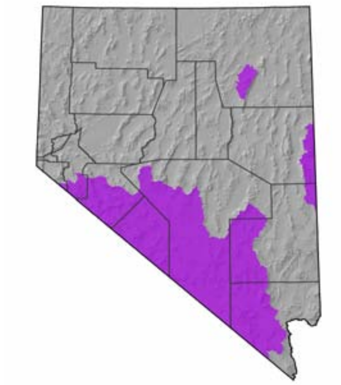
Monitoring and Existing Plans: This species is not currently monitored.

Approach: Determine viability, distribution, and basic demographics of the species. Conduct genetic work to confirm subspecific taxonomy. Monitor populations to determine trend and protect vulnerable populations as appropriate.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands.

Inyo shrew *Sorex tenellus*

WAP 2012 species because of range-wide population status uncertainty.



Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown as is distribution.

DISTRIBUTION: Formerly only known from western and southwestern NV, but Rickart et al (2004) captured an individual at Great Basin National Park, extending the range by 300km.

GENERAL HABITAT AND LIFE HISTORY:

In NV, primarily known as a montane species found in coniferous forest along streams in canyon bottoms. Burt (1934) captured all specimens on Mt. Charleston 300 yards or less from water near decaying logs and along bases of vertical cliffs in shaded, damp situations. However, this species was also collected near the Walker River where the dominant plant species were Artemisia tridentata, Ephedra, and Chrysothamnus (Hall 1946).

Inyo shrews are voracious hunters. They feed primarily on insects and other small invertebrates (worms, molluscs, centipedes, etc.). They may also feed on bodies of wind-borne insects deposited at higher elevations.

No reproductive information is available (Hoffmann and Owen 1980). Inyo shrews are active throughout the year and are not entirely nocturnal, but part crepuscular. Shrews are seldom captured in conventional small mammal traps which may be the reason they are thought of as rare. They are more commonly captured using pitfall traps.

CONSERVATION CHALLENGES:

The distribution and status of this species is poorly understood. Records are patchy and fragmented and it is not clear how populations interact with each other, how close they are, or to what degree the species may be experiencing threats. In general, this species occupies montane areas and could be found in other isolated mountains within the Great Basin.

NEEDS:

Research Needs: Distribution and status of this species needs investigation. Concentrated survey efforts would yield a much clearer picture of species' occurrences and would provide critical habitat information.

Monitoring and Existing Plans: This species is a Medium Priority Evaluation species in the Clark County MSHCP, but otherwise is not currently monitored.

Approach: Determine population status, distribution, and management needs. Conduct presence/absence pit-fall trapping to delineate the range of the species and monitor known locations appropriately. The occurrence record in Great Basin National Park is 300 km northeast of the closest other record; the area in between these records needs to be surveyed, particularly in and around other isolated mountain ranges.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forest and Woodlands, Cliffs and Canyons.

little brown myotis — *Myotis lucifugus*

WAP 2012 species because it has a patchy distribution across the landscape and is never very abundant. In the east, little brown bats are the most critically effected by white-nose syndrome with over 95% mortality in some areas; should the disease spread to the west, it would be a significant threat to the overall viability of the species.

Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
BLM-NV	Sensitive
CCVI	Increase Likely

TREND: The trend of this species is unknown. The species is never commonly captured and does not seem to be overly abundant in Nevada.

DISTRIBUTION: All known records in Nevada are from the Great Basin. No individuals have been captured or acoustically recorded in the Mojave Desert.

GENERAL HABITAT AND LIFE HISTORY:

Throughout its range, little brown bats have adapted to using human-made structures for resting and maternity sites but will also uses caves, hollow trees, and rock outcrops. This species hibernates in the state, presumably in mines and caves. Elsewhere in its range, very large groups of hibernating bats have been found but no such large aggregations of little brown bats have been discovered in Nevada. Likewise, during maternity season, this species often forms very large maternity colonies. As with most cave and mine bats, suitable maternity sites are thought to be a limiting factor.

Little brown bats feed heavily on aquatic insects such as caddis flies, midges, and mayflies, although a variety of other terrestrial insects may be eaten. Foraging occurs in open areas among vegetation, along water margins and sometimes a few feet above the water surface. When young begin to fly, the adults move to more cluttered habitats and leave open foraging areas to juveniles.

CONSERVATION CHALLENGES:

Bats are very vulnerable to disturbance during hibernation, and if disturbed often enough, can deplete their stored fat and starve to death. During the maternity season, bats are particularly sensitive to disturbance and have been known to abandon sites, sometimes leaving their young behind. This species is more tolerant of human disturbance than most bat species, but pinyon-juniper conversion, pesticide spraying, building demolition, pest control, mine reclamation, renewed mining, and cyanide ponds may pose a threat. In the eastern U.S., little brown bats are gravely impacted by white-nose syndrome, with some populations showing greater than 95% mortality. If white-nose syndrome spreads to the west, this could be an especially significant threat to this species.

NEEDS:

Research Needs: Although this is one of the better studied species of bat in the U.S., little is known about specific preferences of the little brown myotis in Nevada, including foraging behavior, reproductive biology, roosting requirements, and population dynamics. Information is needed on the current distribution and status of the species. Particular attention should be focused on locations and characteristics of winter hibernacula.

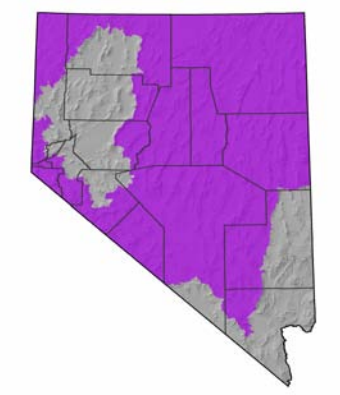
Monitoring and Existing Plans: Little brown bats are addressed in the Revised Nevada Bat Conservation Plan (2006).

Approach: Key hibernation, maternity, bachelor, staging, lekking, and night roost sites should be identified, mapped, and monitored. Critical roosting sites in mines and caves should be conserved and protected by either installing appropriate bat gates, education of the public, road/trail closures or restrictions, or access restrictions. All mines that are proposed to be permanently closed should be properly evaluated for bat habitat prior to closure and should never be closed during the maternity and hibernation seasons. Determine species use of pinyon-juniper woodlands; evaluate impacts of pinyon-juniper woodland conversion. Forest management should include efforts to maintain a variety of seral stages, including old growth and snags. All bats should be monitored for evidence of white-nose syndrome, but for this species, it is especially important.

WAP HABITAT LINKS: Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Caves and Mines, Cliffs and Canyons, Developed Landscapes.

long-eared myotis *Myotis evotis*

WAP 2012 species because it has a patchy distribution across the landscape and is never very abundant; trends and population viability are uncertain and this species could be vulnerable to white-nose syndrome.



Agency Status	
NV Natural Heritage	G5S4
USFWS	No Status
BLM-NV	Sensitive
CCVI	Increase Likely

TREND: Trend is unknown and presumed to be stable in most areas although declines have been reported in the Spring Mountains.

DISTRIBUTION: Long-eared myotis are found throughout the state but are generally considered uncommon.

GENERAL HABITAT AND LIFE HISTORY:

Long-eared myotis are usually associated with coniferous forests. Individuals roost under exfoliating tree bark, and in hollow trees, and occasionally in caves, mines, cliff crevices, sink-holes, and rocky outcrops on the ground. As is typical of most bats, long-eared myotis are long-lived for their small size and are capable of living longer than 20 years. The reproductive rate for this species is low with individuals producing zero to only a single pup per year. This species hibernates in the state. Winter habits of long-eared myotis are unknown in Nevada. Long-eared myotis generally form small maternity colonies of perhaps 12-30 individuals.

This species is well adapted for flight and foraging in dense vegetated habitats and is capable of slow, maneuverable flight that is especially suitable for gleaning insects. It eats moths and small beetles, as well as flies, lacewings, wasps, and true bugs. It is often described as a hovering gleaner that feeds by eating prey off foliage, tree trunks, rocks, and from the ground. It has been reported that long-eared myotis "turn off" their echolocation to listen to their prey, rather than the usual method of constant and then very rapid echolocating when nearing a target.

CONSERVATION CHALLENGES:

There is long term concern for this species due to habitat loss or alteration (mine closures, forest management practices, etc). The lack of knowledge about roosting requirements, especially during the winter, hampers effective management of the species. Bats are very vulnerable to disturbance during hibernation and if disturbed often enough, can burn through their stored fat and starve to death.

NEEDS:

Research Needs: More information is needed about population trends, winter roost requirements, winter range, importance of snags, foraging requirements, and use and acceptance of bat gates.

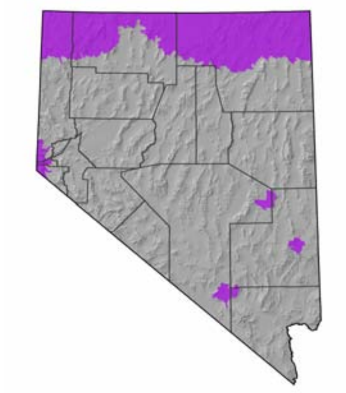
Monitoring and Existing Plans: Long-eared myotis are addressed in the Revised Nevada Bat Conservation Plan (2006) and is a covered species under the Clark County MSHCP.

Approach: Continue monitoring and mapping key habitat for the species, especially hibernating sites. Delineate range more precisely and initiate research to study key aspects of the species' biology. Critical roosting areas should be appropriately protected as knowledge of such sites becomes known. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Aspen, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral, Caves and Mines.

Merriam's shrew *Sorex merriami*

WAP 2012 species because of range-wide status uncertainty and scarce historic records.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend unknown. Although widespread, they appear to be uncommon.

DISTRIBUTION: Found throughout the Great Basin and Columbia Plateau regions in appropriate habitat.

GENERAL HABITAT AND LIFE HISTORY:

Merriam's shrews occurs in the arid Upper Sonoran and Lower Transition life zones, primarily in various grassland habitats, including grasses in sagebrush scrub/pinyon-juniper habitat, and also in mountain-mahogany and mixed woodlands (Clark and Stromberg 1987, Benedict et al. 1999).

Feeds primarily on lepidopteran caterpillars, beetles, cave crickets (Ceuthophilus spp.), ichneumon wasps (Ichneumonidae), and spiders, as well as other arthropods (Johnson and Clanton 1954, cited in Verts and Carraway 1998; Clark and Stromberg 1987). Merriam's shrews have the highest relative bite force of all western shrews studied, indicating that it is adapted to forage on relatively large, hard-bodied prey (Verts and Carraway 1998).

This shrew seems to prefer drier habitat than do other shrews. They may utilize burrows and runways of other animals (Wilson and Ruff 1999) and are active throughout the year. There are some recognized subspecies, some of which may be isolated. For example, S. m. leucogenys is apparently restricted to the Great Basin-Mojave Desert transition zone in Tikaboo Valley in western Lincoln County.

CONSERVATION CHALLENGES:

Merriam's shrews are not thought to be abundant anywhere; at known sites, several hundred trap-nights are needed to capture one animal (Verts and Carraway 1998). Threats to the species are poorly understood, but it is likely that conversion of grassland and shrub steppe habitat due to wildfires and conversion to invasive annual grasses threatens the species. Responses to grazing pressure are unknown (Verts and Carraway 1998).

NEEDS:

Research Needs: This species is poorly understood. Basic information on habitat, current distribution, and status are lacking. Need study of impacts of unsustainable grazing practices, responses and tolerance thresholds to annual grass invasion, transition to rabbitbrush, and pinyon-juniper encroachment.

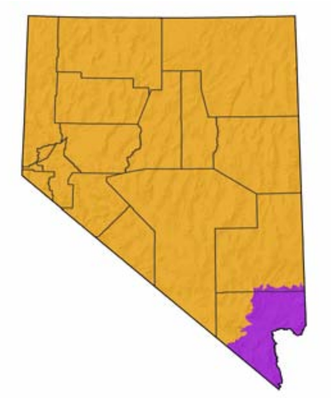
Monitoring and Existing Plans: Not currently monitored and not within any other existing plans.

Approach: Conduct surveys to delineate current habitat status and range as part of a statewide shrew inventory. Research efforts should focus on the responses to habitat change and basic habitat and life history requirements.

WAP HABITAT LINKS: Sagebrush, Lower Montane Woodlands and Chaparral.

Mexican free-tailed bat *Tadarida brasiliensis*

WAP 2012 species because of this species habit of roosting in exceptionally large colonies and because of its vulnerability to decline due to alternative energy development.



Agency Status	
NV Natural Heritage	G5S3S4B
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Presumed Stable

TREND: Appears to be stable on a statewide basis, although localized population declines have been observed. There is some evidence that although this species is still considered abundant, numbers may be well below what they were historically.

DISTRIBUTION: This species is found throughout the state in small colonies. Additionally, two very large colonies exist that probably make up the bulk of the state's population.

GENERAL HABITAT AND LIFE HISTORY:

This species is found in a variety of habitats, from low desert to high mountains. It roosts in a variety of sites including cliff faces, mines, caves, buildings, bridges, and hollow trees. It forms very large colonies (in Nevada up to 70,000-100,000; elsewhere in the millions), although many smaller colonies of hundreds exist throughout the state. Mexican free-tailed bats do not hibernate. They migrate from the state in early fall and it is thought that some caves are used as staging roosts during the migration period. It is possible that in some warmer areas of southern NV, Mexican free-tailed bats may be year-round residents.

Mexican free-tailed bats are opportunistic feeders; diet includes moths, flying ants, beetles, bugs, and other insects. They often prey on densely swarming insects and are an important predator of night-flying moths and other insects, particularly of agricultural pests. Mexican free-tailed bats can fly considerable distances (150 miles) to favorite feeding areas, but typically fly within a 50 mile radius of the day roost. This species is also capable of feeding at very high altitudes (up to 10,000 ft).

CONSERVATION CHALLENGES:

Threatened by human disturbance and habitat destruction. Because this species tends to roost in such large colonies, single disturbance events can have very significant impacts to the species as a whole. Mortality of Mexican free-tailed bats is frequently reported at wind farms and the resulting effects on the larger population are not known. Although it is still unclear exactly how wind turbines induce mortality, it has been proposed that bats are dying from barotrauma, the result of a rapid drop in pressure near moving blades. Mortality is seasonal and coincides with migration periods.

NEEDS:

Research Needs: Large colonies of this species need to be monitored annually. It is thought that perhaps in the eastern part of the state, there are important migration corridors; these should be investigated. In general, more information is needed on seasonal distribution and use patterns.

Monitoring and Existing Plans: Mexican free-tailed bats are addressed in the Nevada Bat Conservation Plan (2006).

Approach: Monitor and protect large colonies of the species. Monitor and survey species to determine impacts of alternative energy development on Nevada populations. This species should also be monitored for evidence of white-nose syndrome.

WAP HABITAT LINKS: Mojave Warm Desert and Mixed Desert Scrub, Warm Desert Riparian, Intermountain Riparian, Lower Montane Woodlands, Aspen, Intermountain Coniferous Forest, Sierra Coniferous Forest and Woodlands, Cliffs and Canyons, Caves and Mines, Developed Landscapes.

Mono Basin mountain beaver *Aplodontia rufa californica*

WAP 2012 species because it is highly vulnerable to climate change, has a limited and patchy distribution with uncertain population connectivity, and is sensitive to disturbance.

Agency Status	
NV Natural Heritage	G5T3T4S1
USFWS	No Status
State Prot	Sensitive Mammal NAC 503.030.3
CCVI	Highly Vulnerable

TREND: Possibly declining in areas close to developing communities and with heavy recreation pressures. Populations apparently stable in more remote areas recently surveyed by NDOW.

DISTRIBUTION: Restricted to wet meadows and brushy riparian zones in the Lake Tahoe Basin and east side of the Carson Range.

GENERAL HABITAT AND LIFE HISTORY:

Restricted to moist environments with moderate to dense vegetation. Surveys along the Truckee River and its tributaries (Deer Creek to Verdi) observed mountain beavers most often on reaches with steeper gradients; narrower and shallower streams; higher elevation; a greater abundance of alder, willow, fir, and aspen; and a lesser abundance of cottonwood and yellow pine (Pinus ponderosa, P. jeffreyi, P. washoensis, and hybrids) than unused reaches. Mountain beaver probably choose habitat based on a cool thermal regime, adequate soil drainage, and abundant food supply (Beier 1989).

Feeds on a wide variety of vegetation; consumes ferns, forbs, and deciduous plants in summer; conifer foliage in fall/winter if other plants are unavailable (Banfield 1974). Forages mainly above ground (Epple et al. 1993). Requires free surface water or succulent vegetation on a daily basis. Caches grasses and forbs for winter food.

Mountain beavers are restricted to moist environments because they have a poor ability to concentrate urine and consequently they require free surface water or succulent vegetation on a daily basis. They are primarily fossorial but can climb trees and swims well (but not arboreal or aquatic). Mountain beavers are active during winter, but remain mostly underground. They are usually solitary but may live in loose colonies. Population density estimates generally range from 4-8 per ha (4-8/2.6 acres), but up to 15-20/ha (15-20/2.6 acres) (see Carraway and Verts 1993). The home range of 10 adults radiotracked for 3-19 months ranged from 0.03 to 0.20 ha (0.07-0.49 acres) (mean 0.12 ha). Juveniles were reported to have moved up to 43 m (141 ft) from the nest (see Carraway and Verts 1993). Significant predators of mountain beavers include coyotes and bobcats.

CONSERVATION CHALLENGES:

In some areas, populations are vulnerable to development, recreation, and habitat alteration. In more remote areas, threats are largely unknown. Habitat availability is patchy and species status is not completely understood.

NEEDS:

Research Needs: Many aspects of biology have been studied, but more information on dispersal and demography is needed. Comprehensive inventories are needed in more remote areas to establish the extent and status of the subspecies found in Nevada. Some genetic work has been conducted but with a limited sample size. Population viability and connectivity need to be assessed.

Monitoring and Existing Plans: As of October 2011, NDOW had completed a three-year project and one-year extensive survey effort for this species. Fifty-one new occupied sites were found, and surveys will continue into 2012, including the collection of tissue samples to conduct genetic studies. This species is not within any other existing plans.

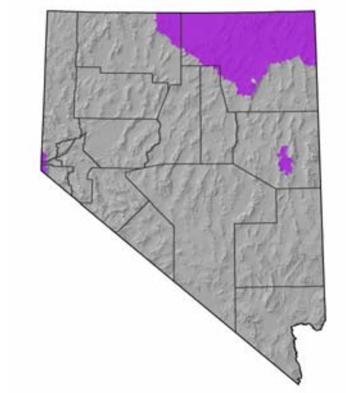
WAP HABITAT LINKS: Sierra Coniferous Forest and Woodlands, Intermountain Riparian, Grassland, Wet Meadow.

Approach: Continue surveys, especially in remote areas where threats are poorly understood. Population status and severity of threats needs to be addressed, as well as connectivity questions between individual locations. Manage known locations with species' long-term persistence as a goal. Recent studies have allowed NDOW to create a more comprehensive map of occupied sites, which facilitates the development of more effective protection zones from recreational impacts.

WAP HABITAT LINKS: Sierra Coniferous Forest and Woodlands, Intermountain Riparian, Grassland, Wet Meadow.

montane shrew — *Sorex monticolus*

WAP 2012 species because they are moderately vulnerable to climate change and because they occur in isolated and disjunct populations that are restricted to sensitive, high elevation riparian areas.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Known from the Tahoe Basin (records exist for Marlette Lake), Ruby Mountains, Eureka County (Evans Range), and Humboldt Counties (Mahogany Creek). Likely to also occur in the Santa Rosas and in the Jarbidge area.

GENERAL HABITAT AND LIFE HISTORY:

Montane shrews occur in boreal and coastal coniferous forest and alpine areas. Various habitats including damp meadows surrounded by coniferous forest, in grass among spruce-fir, mid-elevation fir-larch, along streams and rivers in high prairie, mossy banks of small streams, alpine tundra, and sphagnum bogs have all been reported.

Feeds primarily on insects and other small invertebrates (worms, sowbugs, molluscs, etc.). Also consumes some vegetable matter.

Most individuals probably do not live longer than 18 months. Mean home range estimates are 1,227 sq m (0.3 acre) for nonbreeders and 4,020 sq m (1.0 acre) for breeders (van Zyll de Jong 1983). Montane shrews are apparently not territorial in breeding season and may move widely (van Zyll de Jong 1983).

CONSERVATION CHALLENGES:

Populations are disjunct and patchy, leaving the species vulnerable to isolation and extirpation. Their preferred riparian meadow habitat is sensitive and vulnerable to degradation and conversion, especially from climate change.

NEEDS:

Research Needs: As with most shrews, little is known about the species, including range, viability of subpopulations, and responses to habitat change and isolation. Basic habitat and life history information is lacking and trend of the species needs to be investigated. Presence/absence surveys need to be conducted.

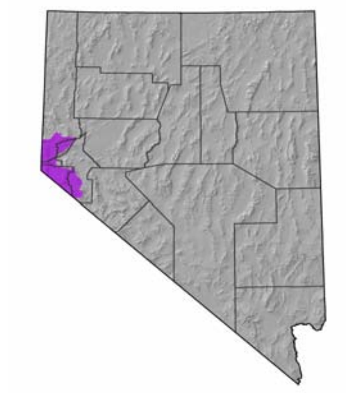
Monitoring and Existing Plans: Not currently monitored.

Approach: Conduct surveys to delineate current habitat status and range as part of a statewide shrew inventory. Research efforts should focus on basic habitat and life history requirements. Protect at-risk populations as appropriate.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands, Aspen, Intermountain Coniferous Forests and Woodlands, Alpine and Tundra, Grasslands and Meadows, Intermountain Riparian.

mountain pocket gopher *Thomomys monticola*

WAP 2012 species because it is a range-restricted species with limited distribution in Nevada and its preferred habitat is sensitive and vulnerable to degradation.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Sierra Nevada of central and northern CA and extreme west-central NV.

GENERAL HABITAT AND LIFE HISTORY:

Mountain pocket gophers occur in mountain meadows and rocky slopes in pine, fir, and spruce (Wilson and Ruff 1999); in rich moist soil, as well as gravelly or rocky ground. They can generally be found on open forest floor and at the edge of meadows. Mountain pocket gophers are found at high altitudes where temperatures are lower than the habitat of other pocket gopher species.

Eats roots, tubers, and some surface vegetation. Mostly forages within their underground burrow system, but occasionally forages on the surface of the ground. During this period, they are at significant risk of predation. Food is collected in external cheek pouches and stored in underground chambers.

Mountain pocket gophers are active throughout the year. They are fossorial and solitary, except during the breeding season. Their underground burrow system may cover 18.6 m2 (200 sq ft) for young animals to 186 m2 (2000 sq ft) for old females. Population density can be 10-35/ha (4-14/acre) and individuals may live up to 4 years in the wild. Overground dispersal is difficult for pocket gophers due to heavy predation. Mountain pocket gophers probably rely on deep snow to allow animals to disperse to new territories. Pocket gophers are ecologically important as prey items and in influencing soils, microtopography, habitat heterogeneity, diversity of plant species, and primary productivity (Huntly and Inouye 1988).

CONSERVATION CHALLENGES:

Mountain pocket gophers are a range restricted species, found only in the Sierra Nevada in the Nevada portion of its range. Its preferred riparian habitat is vulnerable to degradation, especially from climate change.

NEEDS:

Research Needs: Status and trend for this species are unknown. Pocket gopher specific trapping needs to be initiated to help determine microclimate requirements, distribution of the species, and population viability.

Monitoring and Existing Plans: May be monitored by the Tahoe Basin multi-species monitoring program.

Approach: Determine species status and distribution and monitor on a periodic basis.

WAP HABITAT LINKS: Intermountain Riparian, Sierra Coniferous Forests and Woodlands, Grasslands and Meadows.

mule deer — *Odocoileus hemionus*

WAP 2012 species because of significant population declines in conjunction with large-scale habitat degradation and loss.

Agency Status	
NV Natural Heritage	G5S5
USFWS	No Status
State Prot	Game Mammal NAC 503.020
CCVI	Presumed Stable

TREND: Populations have been stable near the long-term average since 2002 and remain significantly higher than historic levels.

DISTRIBUTION: Mule deer are found statewide in appropriate habitat.

GENERAL HABITAT AND LIFE HISTORY:

Mule deer occur in a diversity of habitat types throughout Nevada but occur in highest densities in montane shrub dominated communities. They are often associated with successional vegetation. They are often found on open south-facing slopes in winter. Mule deer browse on a wide variety of woody plants and graze on grasses and forbs. Throughout the year, most activity occurs at dawn and dusk, though nocturnal and daytime activity is common.

Mule deer are a secondary successional species, taking advantage of plant species that are often the result of some type of disturbance. They have a high degree of selectivity, not only for the plant species they choose to eat, but also for the specific parts of the plant and the time of year that a particular plant may be eaten. Browse species include sagebrush, bitterbrush, serviceberry, snowbrush, and snowberry. When deer are feeding on browse, they prefer the most tender parts, the new shoots and tips or leaders. Leaders are the most nutritious, most easily bitten off, most flavorful, and most easily digested part of the browse.

Seasonally, home range size is extremely variable and may be 30-240 ha (74-593 acres) or more and is directly correlated with the availability of food, water and cover. In mountainous regions, mule deer tend to migrate (up to 200+ km (120 miles) from high summer range to lower winter range. In the intermountain west, deer often migrate in response to snowfall patterns. They exhibit high fidelity to individual seasonal ranges (e.g., see Kucera 1992).

CONSERVATION CHALLENGES:

Mule deer populations were estimated at all-time highs in the late 1980s. Habitat loss and degradation are the primary concerns for this species. Invasive weeds, increase in number and frequency of large-scale fires, pinyon-juniper encroachment, decline and loss of montane shrubland, urban development and expansion, and drought all contribute to habitat degradation and loss. Decreases in quality of summer range and loss of critical wintering habitat in particular has been the biggest challenges to the species.

NEEDS:

Research Needs: Delineation of mule deer movement corridors in order to maintain habitat connectivity; develop restoration techniques for montane shrub habitats.

Monitoring and Existing Plans: Mule deer are monitored through annual aerial surveys (NDOW) and managed under the Mule Deer Species Policy Plan (NDOW).

Approach: Collaborative, multi-agency approach to improve/restore mule deer range. Continue to address issues of habitat degradation, pinyon-juniper encroachment, improper livestock and wild horse overgrazing, wildfire, invasive annual grasses and weeds, habitat type conversion, predators, and migration disruption by fences and roads.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands, Alpine and Tundra, Grasslands and Meadows, Agricultural Lands, Cliffs and Canyons.

northern flying squirrel *Glaucomys sabrinus*

WAP 2012 species because of its preference for old-growth forests.

Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
State Prot	Protected Mammal NAC 503.030.1
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: This species is limited to the Sierra Nevada's in the western portion of the state. Northern flying squirrels have not recently been observed in the northwestern corner of the state (Washoe County north of Gerlach) despite the suggestion of certain information sources and extensive survey efforts.

GENERAL HABITAT AND LIFE HISTORY:

Prefers coniferous and mixed forest, but will utilize deciduous woods and riparian woods. Optimal conditions have been reported as cool, moist, mature forest with abundant standing and downed snags. One study in Plumas National Forest in California captured northern flying squirrels exclusively in red fir forests (Coppeto et al. 2006). Although thought to be dependent on old-growth habitat types, NDOW surveys have found that flying squirrels readily use and nest in second-growth forest habitat types (where snags exist as an important habitat component), and Coppeto et al. (2006) reports that this species tolerates some logging disturbance. Occupies tree cavities, leaf nests, witch's broom, and underground burrows. Prefers cavities in mature trees as den sites. Small outside twig nests sometimes are used for den sites. Sometimes uses bluebird boxes.

Flying squirrels forage in tree-tops. Their diet consists largely of fungi and lichens plus plant and animal material (insects, nuts, buds, seeds, fruit). Apparently they can subsist on lichens and fungi for extended periods, and may depend on having these food items available. They also spend considerable time foraging on the ground and will also feed on carrion.

This species is best known for their ability to glide between trees. The apparently live in family groups of adults and juveniles. Flying squirrels are highly social, especially in winter when nests may be shared. Active throughout the year and most active at night.

CONSERVATION CHALLENGES:

This species has a very limited distribution in the state. It tends to be more abundant in old-growth forest and is subject to a number of disturbances associated with forest management. Forestry practices that create openings wider than approximately 120 feet probably have a negative effect on locomotion (Verner et al. 1992).

NEEDS:

Research Needs: A three-year trapping, collaring, tracking, and vegetation community analysis study is currently in progress. The results of this study will also provide nesting requirements and the results of tissue sample analysis.

Monitoring and Existing Plans: This species is not within any other existing plans. NDOW surveys currently in progress with the use of nocturnal camera stations, live-trapping, and tracking collars.

Approach: Focus on old-growth forest conservation and incorporate species' need for downed and dead woody debris into forest management planning (especially for fire management activities). Coppeto et al. (2006) noted that the most cost effective approach to gather data is at the macrohabitat scale (e.g., forest type); however, coarse-scale assessment of the understory structure of forested habitats should also be emphasized.

WAP HABITAT LINKS: Sierra Coniferous Forests and Woodlands.

northern river otter *Lontra canadensis*

WAP 2012 species because it is moderately vulnerable to climate change, has a limited distribution, and its preferred habitat is sensitive and vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
State Prot	Fur-bearing Mammal NAC 503.025
CCVI	Moderately Vulnerable

TREND: Trend is unknown.

DISTRIBUTION: Currently known from the Humboldt River system in northern NV. Historically found in western and southern NV (Hall 1946).

GENERAL HABITAT AND LIFE HISTORY:

Inhabits streams, lakes, ponds, swamps, marshes, and beaver workings. When inactive, occupies hollow log, space under roots, log, overhang, abandoned beaver lodge, dense thicket near water, or burrow of another animal; such sites also are used for rearing young. Uses traditional haul-out sites along the banks of aquatic habitats.

Feeds opportunistically on aquatic animals, particularly fishes (mostly slow-moving, mid-size species), frogs, crayfish, turtles, insects, etc., sometimes birds and small mammals. May hunt over as much as 80-100 km (50-62 miles) of stream during the course of one year.

Home range typically is linear; 32-48 km (20-30 miles) for a pair or male; less for females with young (Jackson 1961). May travel long distances overland, particularly in snow. Active in winter, even in fresh deep snow. More nocturnal in summer. May be active at any time of day. All den sites in NV were originally constructed by beaver, which suggests a strong otter-beaver commensal relationship (Bradley 1986).

CONSERVATION CHALLENGES:

This species is sparsely distributed where it occurs. Concerns for this species are generally linked to riparian community health. Mechanical stream channelization, herbicidal willow removal, unsustainable grazing pressure on flood plains and stream banks, and flood plain gravel mining could negatively impact river otter populations.

NEEDS:

Research Needs: Determine status and distribution of populations in the state (both northern and southern), with particular emphasis on the Truckee and Carson rivers. Research habitat preferences.

Monitoring and Existing Plans: NDOW previously conducted the Humboldt River Study; however, no current surveys or monitoring are in progress. This species is not within any other existing plans.

Approach: Use status and distribution data obtained from research to develop conservation and management needs/strategies for this species. Maintaining productive aquatic habitats may protect extant populations. Explore the possibility of otter reintroduction and habitat restoration efforts.

WAP HABITAT LINKS: Intermountain Riparian.

Pahranagat Valley montane vole — *Microtus montanus fucosus*

WAP 2012 species because it is an endemic species and Nevada has high stewardship responsibility and its preferred habitat is sensitive and vulnerable to degradation.

Agency Status	
NV Natural Heritage	G5T2S1S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Mammal NAC 503.030.3
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Range is less than 40 square miles in the White River Valley, NV.

GENERAL HABITAT AND LIFE HISTORY:

Found in wet meadows; croplands, especially fields and pastures of grass and legumes along fence rows; and, grassy areas by streams and lakes.

Eats grasses and sedges; leaves, stems, and roots of a wide variety of forbs.

This species is active throughout the year. It occupies shallow burrows and surface runways.

CONSERVATION CHALLENGES:

Isolated endemic subspecies occurring in one drainage. Loss and degradation of habitat due to unsustainable management practices, substantial changes in hydrology, or climate change could threaten this subspecies with extinction.

NEEDS:

Research Needs: Need to confirm current population status and conduct a population viability analysis. Survey historical sites to determine if range can be expanded. Continue genetic analyses to confirm range of this subspecies and relationship to nearby populations.

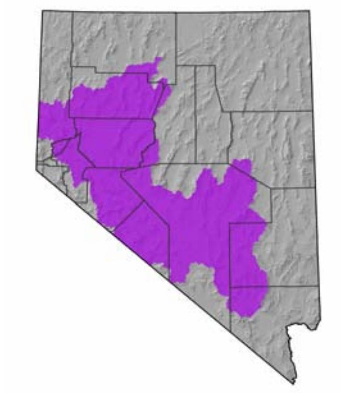
Monitoring and Existing Plans: Recent genetic analyses conducted; however, no current monitoring is being conducted. This species is not within any other existing plans.

Approach: Work with private land owners through USFWS species conservation tools to secure contiguous habitat sufficient to ensure population viability. Work with academic partners (e.g., graduate students from UNR or UNLV) to monitor existing populations annually or at scheduled intervals (not to exceed five years) through live trapping.

WAP HABITAT LINKS: Warm Desert Riparian, Intermountain Riparian, Grasslands and Meadows, Agricultural Lands, Marshes.

pale kangaroo mouse *Microdipodops pallidus*

WAP 2012 species because it is moderately vulnerable to climate change and Nevada has high stewardship responsibility for this species.



Agency Status	
NV Natural Heritage	G3S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Protected Mammal NAC 503.030.1
CCVI	Moderately Vulnerable

TREND: Some populations in decline; population size unknown.

DISTRIBUTION: West and west-central NV and extreme eastern CA.

GENERAL HABITAT AND LIFE HISTORY:

This species is a highly specialized sand-obligate. It is typically restricted to fine, loose, sandy soils (with little or no gravel overlay) in valley bottoms dominated by saltbush and greasewood. It may also be found near sagebrush at its higher elevation range. Elevations range between 1,189 and 1,829 meters.

Primarily granivorous; eats Indian rice grass and a variety of forbs. Summer diet is supplemented with insects including beetles, centipedes, and moth pupae. Seeds may be stored and conserved during periods of food shortage.

Trapping results show that pale kangaroo mouse is among the least abundant of the nocturnal desert rodents in sandy habitats of the Great Basin (Hafner et al. 2008). Hafner et al. 2008 also documented that the geographical distribution of this species has remained remarkably unchanged over the last 75 years (i.e., since Hall's work). However, there is evidence of some populations that may be extirpated near urban areas such as near Dayton, NV (G. Baumgartner, pers. comm., 2011). Despite climate change concerns, no evidence was noted for any natural, systematic distributional changes. This species may undergo periods torpor. Spring/summer torpor is brief and employed only when starving, and multi-day torpor may occur in winter (French 1989). Pale kangaroo mouse is active just after sundown and is active throughout the night.

CONSERVATION CHALLENGES:

Stressors include fire, invasion of exotic species, development, and improper livestock grazing (Hafner et al. 2008).

NEEDS:

Research Needs: Conduct population abundance and trend studies to determine the population status. Perform movement/dispersal studies to learn this species tolerance for unsuitable habitat. Conduct trapping studies at historic capture sites (e.g., Dayton, intersection of Hwy. 50 and Alt. 50).

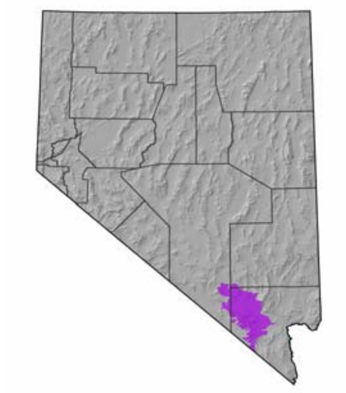
Monitoring and Existing Plans: This species is monitored through a statewide small mammal inventory and trapping network. It is not covered under any other existing plans.

Approach: Implement research needs; monitor via statewide small mammal network; and develop a conservation plan if there is a demonstrated need.

WAP HABITAT LINKS: Intermountain Cold Desert Scrub, Sagebrush, Grasslands and Meadows, Sand Dunes and Badlands.

Palmer's chipmunk *Neotamias palmeri*

WAP 2012 species because this is an endemic species and Nevada has high stewardship responsibility, its populations are fragmented and isolated to one mountain range, its preferred habitat is of concern, and it is highly vulnerable to climate change.



Agency Status	
NV Natural Heritage	G2S2
USFWS	No Status
State Prot	Sensitive Mammal NAC 503.030.3
IUCN	Endangered
CCVI	Highly Vulnerable

TREND: Palmer's chipmunk is the most abundant diurnal mammal in the Spring Mountains (Lowrey and Longshore 2010); however, according to the Clark County MSHCP, it appears that populations are either locally increasing or decreasing depending on the uses and disturbances (particularly recreational) occurring in specific areas.

DISTRIBUTION: This species is endemic to the Spring Mountains, Clark County, NV.

GENERAL HABITAT AND LIFE HISTORY:

Recent studies consider this species a habitat generalist within relatively mature coniferous forests. It is primarily associated with white-fir/limber/mixed conifer associations between 2,600 and 2,900 meters but has also been observed from the upper elevations of pinyon/juniper (2,080 m) to above the Bristlecone timber line (3,290 m). Habitat modeling determined that decreasing understory tree density and increasing currant berry shrub density increased the numbers of Palmer's chipmunks. Other important habitat characteristics that increase the likelihood of occurrence include lower slopes, nearness to permanent water sources, and northern aspects (Lowrey and Longshore 2010).

The primary food source is conifer seeds (Lowrey and Longshore 2010). Currant berries provide food resources in the late summer. This species may also eat other seeds, fruits, fleshy fungi, green vegetation, and insects.

Palmer's chipmunk has a narrow thermoneutral zone (32-34° C) and develops hyperthermia at temperatures above 34° C. It digs deep burrows to survive cold winter periods. It typically occurs on north-facing slopes where vegetation cover is greater (Lowrey and Longshore 2010).

CONSERVATION CHALLENGES:

This species is a Spring Mountains endemic. Threats include competition with recreationists for spring and stream areas, urban development, feral cats, and increased human-caused fires (Lowrey and Longshore 2010). Other threats include fire suppression and fuels management, dispersed and concentrated recreational activities, trail construction and maintenance, and wood removal.

NEEDS:

Research Needs: Research, using a grid-based approach, population dynamics, habitat relationships, and this species' ability to reproduce related to its habitat. Understand the effects of human-caused disturbance (e.g., recreation, feral cats, suburban development) and gain knowledge on source-sink and predator-prey dynamics and density dependent processes. Movement, home range, dispersal patterns and behavioral interactions between Palmer's chipmunk and golden mantled ground squirrel should also be studies as well as the effects of fire ecology and other natural disturbance regimes on populations.

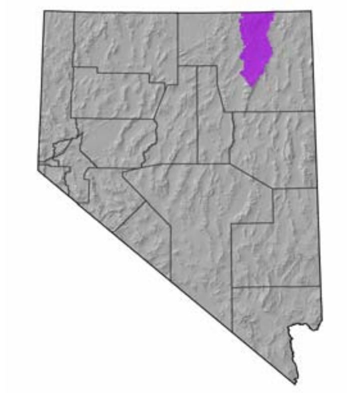
Monitoring and Existing Plans: Annual surveys for this species are conducted by NDOW. This is a Covered Species under the Clark County MSHCP.

Approach: Habitat modeling conducted by Lowrey and Longshore (2010) suggest that Lee, Macks, MacFarland, and Deer Creek Canyons be incorporated into conservation planning actions. Long-term monitoring should include population abundance, survival rates, and recruitment rates or juvenile survival. Continue monitoring threats to habitat, conserve areas important to long-term persistence, and focus on protecting this species from the detrimental effects of human activity. Continue integrating management recommendations, guidelines, and strategies set forth in the Clark County MSHCP.

WAP HABITAT LINKS: Intermountain Coniferous Forests and Woodlands, Lower Montane Woodlands and Chaparral.

Preble's shrew *Sorex preblei*

WAP 2012 species because of range-wide population status uncertainty.



Agency Status	
NV Natural Heritage	G4S1S2
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Trend unknown.

DISTRIBUTION: Found in Elko Co, near Sheep Creek in the Independence Mountains, and along Mary's River. Also collected at Sheldon National Antelope Refuge.

GENERAL HABITAT AND LIFE HISTORY:

Likely habitat is ephemeral and perennial streams dominated by shrubs, primarily below 2500 m. Recorded habitats include arid and semiarid shrub-grass associations, openings in montane coniferous forests dominated by sagebrush (WA), willow-fringed creeks, marshes (OR), bunchgrass associations, sagebrush-aspen associations (CA), sagebrush-grass associations (NV), and alkaline shrubland (UT) (Hoffman et al. 1969, Williams 1984, Cornely et al. 1992).

Preble's shrew is an invertivore. Feeding habits probably resembles other shrews in that they primarily feed on insects and other small invertebrates (worms, molluscs, centipedes, etc.).

They are active throughout the year and can be active at any time throughout the day or night, but probably most active during morning and evening hours.

CONSERVATION CHALLENGES:

Rarity may be a reflection of a lack of intensive sampling effort. Little is known about this species, although general concerns related to sagebrush/riparian habitat quality apply.

NEEDS:

Research Needs: As with most shrews, little is known about the species, including range, viability of subpopulations, and responses to habitat threats and isolation. Basic habitat and life history information is lacking and trend of the species needs to be investigated. Presence/absence surveys need to be conducted.

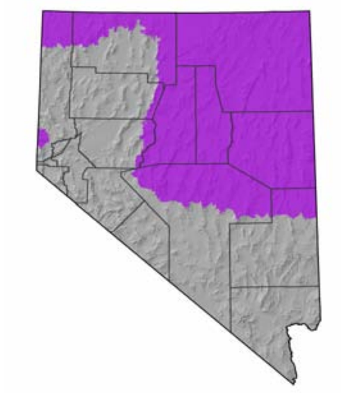
Monitoring and Existing Plans: NDOW has conducted recent surveys on the Marys and upper Humboldt River watersheds. Otherwise the species is not monitored.

Approach: Conduct surveys to delineate current habitat status and range as part of a statewide shrew inventory. Research efforts should focus on basic habitat and life history requirements. Careful consideration should be given to research methods and the risks/benefits evaluated since the best ways to capture this species are typically lethal (pitfall or sticky traps). Protect at-risk populations as appropriate.

WAP HABITAT LINKS: Sagebrush, Intermountain Riparian, Aspen, Intermountain Coniferous Forest, Sierra Coniferous Forests and Woodlands, Grasslands and Meadows.

pygmy rabbit *Brachylagus idahoensis*

WAP 2012 species because of the potential for large-scale sagebrush habitat conversion and loss, perceived population declines, extreme vulnerability to climate change, and chronic listing concerns.



Agency Status	
NV Natural Heritage	G4S3
USFWS	No Status
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Game Mammal NAC 503.020
CCVI	Extremely Vulnerable

TREND: Trend unknown.

DISTRIBUTION: Range includes central and northern NV, corresponding to sagebrush distribution. Recent surveys have increased our knowledge of the range of this species in NV (USFWS 2010b).

GENERAL HABITAT AND LIFE HISTORY:

Found primarily on big sagebrush dominated plains, and alluvial fans where plants occur in tall, dense clumps (Green and Flinders 1980). Deep, friable, loamy-type soils are required for burrow excavation. They may occasionally use burrows excavated by other species (e.g., yellow-bellied marmot), therefore, may occur in areas that support shallower, more compact soils as long as sufficient shrub cover is available (USFWS 2010b). Dense stands of sage growing adjacent to permanent and intermittent streams, along fence rows, and ditches may be avenues of dispersal (Green and Flinders 1980). Cover and height of woody vegetation appear to be critical habitat features (Green and Flinders 1980); however, Larrucea and Brussard (2008) found that pygmy rabbits occupied clusters of sagebrush that were taller/higher than the sagebrush shrubs in the surrounding area (i.e., sagebrush islands which ranged from 12-117cm in height).

Big sagebrush is the primary food which may comprise up to 99% of food taken in winter and 51% in the summer. Wheatgrass and bluegrass were highly preferred foods in the summer, while forbs were eaten only occasionally (Green and Flinders 1980).

This is the only native leporid in NV to excavate its own burrows (Weiss and Verts 1984; Janson 1946). Dispersal abilities are limited; this species is reluctant to cross open areas such as roads or areas cleared of sagebrush (Weiss and Verts 1984). The size of pygmy rabbit home ranges fluctuate with the seasons; they tend to have smaller home ranges during winter and larger home ranges during the spring and summer. Individuals generally remain near their burrows during the winter (one study noted within 30 m and another within 80-100 m). One study found that annual home ranges in southeastern Oregon and northwestern Nevada differed between the sexes and ranged from 1.2 to 25.8 ac (0.49 to 10.46 ha) for males and 0.27 to 18.7 ac (0.11 to 7.55 ha) for females. Male home ranges tend to be larger than females during the spring and summer as males travel further among a number of females. In the southeastern Oregon and northwestern Nevada study, home ranges for males ranged from 0.27 to 18.5 ac (0.11 to 7.49 ha) and from 0.15 to 17.5 ac (0.06 to 7.10 ha) for females during the breeding season. Juvenile dispersal in Nevada and Oregon was reported greater than 0.3 mi (0.5 km) with a maximum long-distance movement of 5.3 mi (8.5 km) recorded by a juvenile female.

CONSERVATION CHALLENGES:

Livestock grazing at unsustainable levels can result in the degradation of sagebrush habitat. Recent studies show that grazing was compatible with pygmy rabbits if grazing occurs at levels that left sagebrush plants in tact and soils not overly compacted. Fire was found to be the strongest predictor of loss of pygmy rabbits from a site in Nevada and California. Cheatgrass invasion is detrimental to pygmy rabbits. Shrub cover is necessary for protection during dispersal and cheatgrass monocultures may provide a barrier to dispersal. Pinyon-juniper encroachment decreases understory species and, in turn, decreases suitable pygmy rabbit habitat. Climate change has been attributed to an upward elevational shift in pygmy rabbit occurrences. Extant historical pygmy rabbit sites averaged 515 ft (157 m) higher than extirpated sites. With local downward shift effect accounted for, overall upward elevation shift of extant sites was 721.8 ft (220 m); the researchers attributed this to climate (USFWS 2010b).

WAP HABITAT LINKS: Sagebrush.

NEEDS:

Research Needs: Conduct a statewide pygmy rabbit inventory. Determine thresholds for habitat requirements. Gain a better understanding of dispersal ability and connectivity among habitat areas. Increase our understanding of how sagebrush treatments and pinyon-juniper removal conducted to benefit Greater Sage-Grouse may affect pygmy rabbits. Preliminary research indicates that a buffer of at least 40 m (131.2 ft) should be established between pygmy rabbit burrows and sagebrush treatment areas. Study the recolonization of previously disturbed sites that are now exhibiting suitable habitat features post restoration.

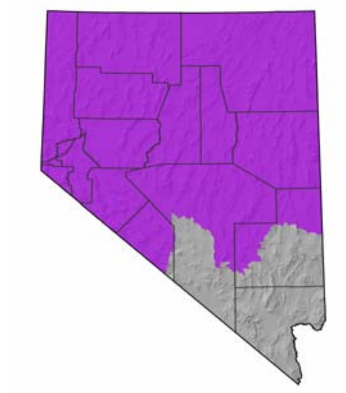
Monitoring and Existing Plans: Species investigation being conducted by NDOW. Pygmy rabbit is not covered within any other existing plans. A recent 12-month finding published by the USFWS (2010b) determined that protection of this species as endangered or threatened was not warranted.

Approach: Protection of sagebrush is critical, particularly in areas where deep soils occur, or on flood plains where high water tables allow the growth of tall, dense stands of Wyoming sagebrush. Monitor populations in order to determine response to habitat changes.

WAP HABITAT LINKS: Sagebrush.

sagebrush vole *Lemmiscus curtatus*

WAP 2012 species because it is highly vulnerable to climate change and due to potential large-scale sagebrush habitat conversion and loss.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
CCVI	Highly Vulnerable

TREND: Generally abundant in suitable habitat; trend unknown; habitat loss to fire has been extensive.

DISTRIBUTION: Statewide, excluding Mojave Desert and Sierra Nevada regions.

GENERAL HABITAT AND LIFE HISTORY:

Live in semiarid habitats on well-drained or rock-covered soils. Vegetation usually dominated by sagebrush or rabbitbrush mixed with bunchgrass. Small mammal live trapping conducted in the late 1990's incidentally observed that the highest densities of sagebrush voles were found in higher elevation mountain sage areas (e.g., Mt. Grant) (J. Boone, unpub. data). This species is known to occur up to 12,500 feet in elevation in other states, but their elevational range in Nevada is unknown.

Entirely vegetarian and eats almost any green plant material including grasses, leaves, green seed heads and pods, flowers and stalks of buckwheat, and some sagebrush leaves. They do not store food but occasionally pull fresh food into their burrow to prevent its drying out.

Occurs in colonies. Active essentially throughout day, year round, but main activity period is 2-3 hours before sunset to 2-3 hours after full darkness, and a similar period around sunrise.

CONSERVATION CHALLENGES:

There is concern over the stability of its sagebrush habitat, particularly the transitioning of sagebrush classes into uncharacteristic classes invaded by annual grasses and weeds and pinyon-juniper encroachment caused by unsustainable grazing, wildfire, and climate change.

NEEDS:

Research Needs: Conduct inventories and determine distribution, upper elevation range limits, population status, and trend. Increase our understanding of how habitat change affects population densities and habitat use.

Monitoring and Existing Plans: This species is monitored by the Wildlife Action Plan Performance Indicators Project but is not addressed by any other existing plans.

Approach: Include this species in a statewide small mammal inventory and trapping network. Develop a habitat suitability model. Conserve and restore sagebrush.

WAP HABITAT LINKS: Sagebrush.

Sierra Nevada snowshoe hare — *Lepus americanus tahoensis*

WAP 2012 species because it is an isolated subpopulation with limited habitat connectivity and shared stewardship with California.

Agency Status	
NV Natural Heritage	G5T3T4QS3
USFWS	No Status
State Prot	Game Mammal NAC 503.020
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Sierra Nevada in the vicinity of Lake Tahoe.

GENERAL HABITAT AND LIFE HISTORY:

Typically occur in dense deciduous streamside vegetation, forest undergrowth, dense thickets of young conifers, especially firs where the branches droop to the ground, and patches of chaparral composed of ceanothus and manzanita. During the summer, snowshoe hares in the Lake Tahoe area are associated with brush situated close to meadows or deciduous riparian vegetation rather than on ridgetops or brush-covered upper slopes (Collins 1998). Recent studies conducted by NDOW detected snowshoe hares in young fir communities adjacent to larger aspen communities, and within newly treated aspen stands with moderate to heavy understory return.

In the summer, snowshoe hares feed on various green succulent plants, grasses, sedges, ferns, and forbs. In the winter, their diet changes to bark and twigs of conifers, evergreen shrubs, and deciduous trees such as aspen, alder, and willow (Collins 1998).

This species is nocturnal and secretive. They do not excavate burrows. Home ranges typically fixed for an adult's life; however, home range shifts in excess of 400 m have been documented. Populations can move seasonally from winter to summer home ranges based on snow accumulation and habitat changes (Feldhamer et al. 2003).

CONSERVATION CHALLENGES:

Vulnerable to loss and degradation of riparian habitat due to logging activities, grazing, wildfires, development, and any other activities that remove or alter areas of brushy cover (Collins 1998).

NEEDS:

Research Needs: NDOW field studies are ongoing to determine this species' distribution, abundance, population status, habitat requirements, home range size, etc.

Monitoring and Existing Plans: This species is not within any other existing plans. NDOW began monitoring this species in 2006 and extensive studies will continue for several years. Occupied sites observed will be monitored using pellet count grids. Trapping studies are planned to determine habitat requirements, home range, and connectivity.

Approach: Protection of brush and alder/willow riparian habitats is the most important element to ensuring their survival (Collins 1998).

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Sierra Coniferous Forests and Woodlands, Grasslands and Meadows.

silver-haired bat *Lasionycteris noctivagans*

WAP 2012 species because of regional population concerns and is very vulnerable to decline due to alternative energy development.

Agency Status	
NV Natural Heritage	G5S3B
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Status and trend is unknown. In some areas, they can be locally common during the summer.

DISTRIBUTION: Can be found throughout the state, especially during migration. Roosting habitat is limited primarily to forested habitats.

GENERAL HABITAT AND LIFE HISTORY:

Silver-haired bats are a forest-associated species and are more commonly found in mature forests. They are found primarily at higher latitudes and altitudes in coniferous and mixed deciduous/coniferous forests of pinyon-juniper, subalpine fir, white fir, limber pine, aspen, cottonwood, and, willow. In southern Nevada, they are usually found at lower elevations in association with riparian corridors. Current Nevada records indicate this species is distributed between 480-2,520 m. In some areas there appears to be summer segregation of the sexes. Silver-haired bats migrate from the state during winter, and only recently have been documented to breed here. It was previously thought they only migrated through each year.

Forages for a wide variety of insects, including chironomids, although moths appear to be a major portion of its dietary prey. Foraging is generally above the canopy layer in or near wooded areas and along edges of roads, streams or water bodies. Silver-haired bats can travel considerable distances (up to 15 km) to preferred foraging areas.

CONSERVATION CHALLENGES:

Threatened by loss of roosting habitat due to logging practices that eliminate clusters of large snags and by loss of foraging habitat in riparian areas. Mortality of silver-haired bats is frequently reported at wind farms and the resulting effects on the larger population are not yet quantified. Although it is unclear exactly how wind turbines induce mortality, it has been proposed that bats are dying from barotrauma, the result of a rapid drop in pressure near moving blades. Mortality is seasonal and coincides with migration periods.

NEEDS:

Research Needs: Recent captures of lactating females provides reliable evidence that this species does breed within NV. Extent of breeding range, numbers of summer residents, and locations of roosts are completely unknown and need to be investigated. Information about breeding populations, roost requirements, and the timing and patterns of migration, as well as status and trend, are necessary.

Monitoring and Existing Plans: The silver-haired bat is addressed in the Revised Nevada Bat Conservation Plan (2006) and is a Covered Species under the Clark County MSHCP.

Approach: Monitor and survey species to determine impacts of alternative energy development on Nevada populations. Basic survey work for key roosting and foraging sites needs investigation. Determine trend and distribution. Care should be taken to maintain temporary roosts along migration corridors. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Intermountain Riparian, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forests and Woodlands, Sierra Coniferous Forests and Woodlands.

spotted bat *Euderma maculatum*

WAP 2012 species because of its rare and patchy occurrences and because it is listed as threatened in the Nevada Administrative Code (NAC).

Agency Status	
NV Natural Heritage	G4S2
USFWS	No Status
BLM-NV	Sensitive
USFS-R4	Sensitive
State Prot	Threatened Mammal NAC 503.030.2
CCVI	Presumed Stable

TREND: Trend is unknown as this species is difficult to survey and monitor.

DISTRIBUTION: This species is patchily distributed throughout the state and linked to prominent rock features (i.e., cliffs) that are used for roosting. Spotted bats are rarely encountered in surveys, although acoustic sampling methods are broadening our understanding of the species distribution.

GENERAL HABITAT AND LIFE HISTORY:

Spotted bats are found in a wide variety of habitats from low elevation desert scrub to high elevation coniferous forests if suitable roosting habitat exists. This species primarily roosts in cracks and crevices associated with cliff faces but there is some indication that mines and caves may be occasionally used, especially in winter. Spotted bats have occasionally been found roosting on or in buildings elsewhere in their range, but their reliance on such roosts is not well understood. This species is a year round resident that hibernates during the winter but periodically arouses to forage and drink. Hibernacula characteristics are completely unknown for this species in Nevada. Spotted bats tend to roost singly or in small clusters and are known to move among various cracks and crevices within large cliff features.

Spotted bats forage primarily on moths, but do not appear to select particular moth species. They likely feed on any moth they encounter that is appropriate handling size (8-12 mm in length).

Foraging occurs in canyons, in the open, over riparian vegetation, over meadows, along forest edges, or in open coniferous woodland, often 10-15 m high. Spotted bats are capable of rapid, long-distance flight and can access suitable foraging grounds some distance away from roost sites. In some areas (e.g., Colorado), they have been reported to consistently forage in the same areas each night, arriving at the same points at routine times. They are infrequently captured possibly due to noise and light sensitivity, or because they fly high enough to avoid mist nets.

CONSERVATION CHALLENGES:

Threats may include recreational rock climbing, broad-scale urban development, pesticide use, loss of foraging habitat, grazing/meadow management, mining and quarry operations and loss of accessible, open water.

NEEDS:

Research Needs: More information is needed on life history, ecology, reproduction, habitat use, patterns of movement, distribution, status, breeding range, and abundance. Also need more information on winter habitats and hibernacula microclimates. Little is known about foraging behavior, population dynamics, and specific roosting requirements. Roosts are difficult to find, and the preference of spotted bats to roost singly and change roosts frequently only compounds the problem. In addition, spotted bats are thought to fly later in the evening than other bats, and may often be missed in capture studies that do not attempt to catch bats all night long.

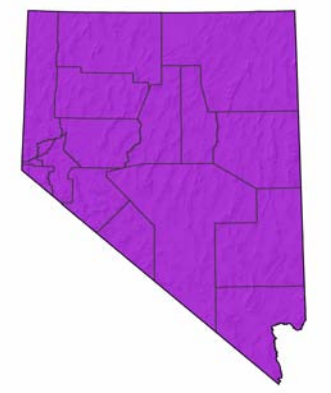
Monitoring and Existing Plans: Spotted bats are discussed in the Nevada Bat Conservation Plan (2006). This species is also a Watch List species in the Clark County MSHCP.

Approach: Critical roosting areas should be identified and protected. Sampling should focus on habitat specific to this species. Acoustic sampling may be helpful in increasing our understanding of this species, but it is important that the right kind of microphone is used for recording as this species calls are at much lower frequencies than other species. The results of status and distribution studies recommended under Research Needs will help determine management needs. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Intermountain Riparian, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forest and Woodlands, Sierra Coniferous Forests and Woodlands, Cliffs and Canyons, Caves and Mines, Developed Landscapes.

Townsend's big-eared bat *Corynorhinus townsendii*

WAP 2012 species because of its patchy distribution, rangewide population status concerns, and possible susceptibility to white-nose syndrome.



Agency Status	
NV Natural Heritage	G3G4S2
USFWS	No Status
BLM-NV	Sensitive
State Prot	Sensitive Mammal NAC 503.030.3
CCVI	Presumed Stable

TREND: Declining throughout the state.

DISTRIBUTION: Although this species can be found throughout the state, it is restricted to caves and mines with suitable microclimates.

GENERAL HABITAT AND LIFE HISTORY:

Roosting habitats are usually mines, caves, and other cave-like spaces with populations occurring in areas dominated by exposed, cavity forming rock and/or historic mining districts. Maternity and hibernation colonies typically are in caves and mine tunnels. Hibernacula are generally in relatively cold places, often near cave or mine entrances and in well-ventilated areas. This species does not use crevices or cracks; it hangs from the ceiling, generally near the zone of total darkness (Schmidly 1991). In Nevada, all known roosts sites are in abandoned mines. Found at elevations between 210 and 3,500 m in pinyon-juniper-mahogany, white fir, blackbrush, sagebrush, salt desert scrub, agricultural, and occasionally urban habitats. Foraging associations include the edge of habitats along streams, adjacent to and within a variety of wooded habitats.

Townsend's big-eared bats are moth specialists; over 90% of its diet is composed of lepidopterans.

This species is nimble; it is able to fly through narrow passages (Hoffmeister 1986). These bats often travel large distances while foraging, including movements of over 150 kilometers during a single evening. Females gather in small nursery colonies in the warm parts of caves or mines, sometimes in buildings (western U.S.). Individuals generally return to the same maternity roost in successive years. Males tend to roost singly, spread across the landscape. Suitable maternity sites seem to be a limiting factor.

CONSERVATION CHALLENGES:

This species is highly susceptible to human disturbance and is most threatened by disturbance or destruction of roost sites through vandalism, recreational caving, mine reclamation, renewed mining, and permanent mine closures. Townsend's big-eared bats have a habit of roosting openly within mines, with some individuals often found near the entrance, making them more easily detected and disturbed than other species that hide in crevices. Maternity colonies are particularly sensitive and females have been known to abandon their young due to a single disturbance event. Similarly, during hibernation, because they roost in the open, they are easily observed and disturbed often causing individuals to use up stored fat and starve to death. Townsend's big-eared bats are also mine and cave obligates; therefore, are not flexible in their roosting needs. Maternity colonies seem to be fairly limited and never abundant; surveys almost always find at least one individual in a mine, but these are generally single bachelor males. Additional threats include timber harvest practices and loss of riparian habitat. Although there have not been any studies to confirm such impacts, pesticide spraying in forested and agricultural areas could affect the prey base (moths) of these bats. Threats to populations of these bats may also include the loss of genetic diversity and population connectivity due to reduced population sizes or available roost sites.

NEEDS:

Research Needs: Although this species is commonly surveyed for and found, basic biological information is still lacking, and the location of critical roosts is needed. More information is needed on foraging requirements, seasonal movement patterns, population genetics (i.e. the degree of relatedness within and between different maternity roosts), and susceptibility to white-nose syndrome. Roost shifting has been observed elsewhere and needs investigation within NV. This may include the study of limiting factors (e.g., microclimate requirements) that affect roost requirements.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Caves and Mines.

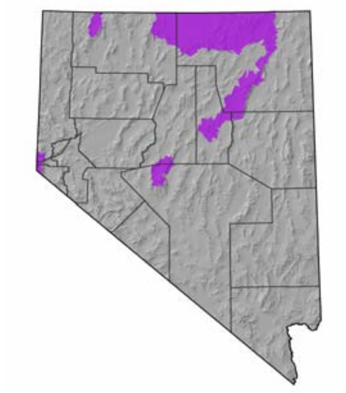
Monitoring and Existing Plans: Townsend's big-eared bats are addressed in the Nevada Bat Conservation Plan (2006), a 1999 Conservation Strategy (Pierson et al. 1999), and are Evaluation Species under the Clark County MSHCP.

Approach: Continue to map and monitor species occurrences of winter, maternity, bachelor, lekking, and night roosts. Ensure adequate biological surveys are conducted prior to mine closures to determine if bats occur. Coordinate protection measures such as installation of bat gates or access restrictions with appropriate land management agencies. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Lower Montane Woodlands and Chaparral, Caves and Mines.

western jumping mouse *Zapus princeps*

WAP 2012 species because it is vulnerable to decline due to large-scale habitat conversion and loss, especially with respect to climate change.



Agency Status	
NV Natural Heritage	G5S2
USFWS	No Status
CCVI	Presumed Stable

TREND: Trend is unknown.

DISTRIBUTION: Found in northeast, central, and western Nevada.

GENERAL HABITAT AND LIFE HISTORY:

Western jumping mice occur in mountain meadows, marshes, and along banks of streams and ponds, in dense cover of tall grasses and herbs. They nest in burrows in well-drained mound or elevated banks (Jones et al. 1983) or on the surface among vegetation.

In spring, this mouse feeds on insects and other invertebrates. By mid-summer, its diet may shift to mostly grass seeds and small fruits.

Western jumping mice are primarily solitary. Their home range in UT averaged 0.2-0.6 ha (0.5-1.5 acres) in different areas in different years (Cranford 1983). Adult density was 8-32/ha (8-32/2.5 acres) in different areas. Adults may enter hibernation September-October. Throughout winter, periods of hibernation alternate with arousal from torpor. During years when summers are relatively short, there is high juvenile mortality because the young have not been able to sufficiently accumulate enough fat reserves to survive the winter. In one study of climate change effects in the Ruby Mountains, western jumping mice showed upslope contractions at their lower range limits while also expanding its upper range limit some 600 meters (Rowe et al. 2010). This may be due to the fact that this species has specific optimum temperature requirements for hibernation and as climate change causes higher elevations to warm, this species may be able to successfully move higher into these warming zones to hibernate.

CONSERVATION CHALLENGES:

This species preferred riparian habitat is vulnerable to degradation and/or loss, especially with respect to climate change. In some areas, fire could also be a concern.

NEEDS:

Research Needs: It is important to determine western jumping mice current distribution in Nevada, compared to its historic distribution. Its dependence on riparian habitat quality needs to be better understood and this species response to climate change should be documented.

Monitoring and Existing Plans: This species is not currently systematically surveyed or monitored.

Approach: Implement statewide small mammal inventory and trapping network and monitor shifts in range or other responses to climate change. Determine population status and distribution; assess population connectivity and the viability of fragmented sub-populations, and protect occurrences as appropriate.

WAP HABITAT LINKS: Intermountain Riparian, Aspen, Grasslands and Meadows.

western red bat *Lasiurus blossevillii*

WAP 2012 species due to its dependence on montane riparian habitat, a vulnerable habitat type.

Agency Status	
NV Natural Heritage	G5S1M
USFWS	No Status
BLM-NV	Sensitive
USFS-R5	Sensitive
State Prot	Sensitive Mammal NAC 503.030.3
CCVI	Presumed Stable

TREND: Trend is unknown. Known populations are local and rare.

DISTRIBUTION: Thought to be restricted to riparian habitats along the western and southern edges of Nevada, so range is probably not extensive. Confirmed breeding in Fallon in 2009.

GENERAL HABITAT AND LIFE HISTORY:

Western red bats are primarily found in wooded habitats, including mesquite bosque and cottonwood/willow riparian areas. This species roosts in tree foliage and possibly in leaf litter on the ground. The seasonal behavior of this species is not well understood. Previously, it was thought to be a migrant only, but recent studies have indicated that it is a summer resident in the Fallon and Muddy River areas. Breeding has been confirmed in a private orchard in Fallon. Western red bats probably migrate from Nevada in winter. This species roosts singly.

Food items consist of a wide variety of insects, taken opportunistically apparently based on size rather than type.

Generally forage high above the tree canopy, often making capture and detection of this species very challenging.

CONSERVATION CHALLENGES:

Degradation and loss of riparian zones, particularly mature cottonwood overstory, is the constant threat to red bats. The intensive use of pesticides in fruit orchards may constitute a threat to roosting bats and may significantly reduce the amount of insect prey available. Controlled burns may be another significant mortality factor for red bats that roosting in leaf litter during cool temperatures.

NEEDS:

Research Needs: Little is known about seasonal movement patterns, reproductive biology, population dynamics, and specific roosting requirements. Tree roosting species are particularly difficult to survey as these species often roost singly or in small groups and frequently shift roosting sites. Research studies should focus on conducting widespread, fine scale inventories using acoustic equipment to document this species distribution and seasonal use, delineating its tree roosting requirements, and documenting the change in abundance and distribution of cottonwood galleries and other riparian areas in the state. The status of this species needs further study and documentation. Other needs include altitudinal distribution, the effects of controlled burns, and the effects of pesticide use in orchards.

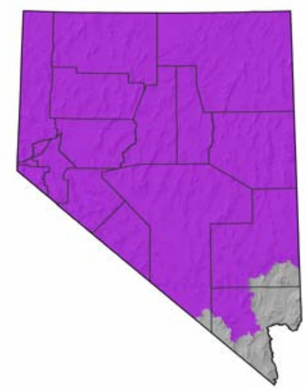
Monitoring and Existing Plans: Red bats are addressed in the Nevada Bat Conservation Plan (2006). This species is covered under the Lower Colorado River MSCP.

Approach: Key roosting sites should be identified, mapped, and monitored. Develop management strategies for large cottonwood gallery groves, including restoration of degraded stands and replacement of lost habitat. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Intermountain Riparian, Warm Desert Riparian.

western small-footed myotis *Myotis ciliolabrum*

WAP 2012 species due to regional population concerns in the west and its potential vulnerability to white-nose syndrome.



Agency Status	
NV Natural Heritage	G5S3
USFWS	No Status
BLM-NV	Sensitive
CCVI	Presumed Stable

TREND: Although western small-footed myotis are found throughout the state, there is a general lack of knowledge of its status and trend.

DISTRIBUTION: This species has been captured throughout the state. There is some evidence that in the south, this species is primarily found at the middle and higher elevations (>1,800 m) although occasionally found at lower elevations. In the central and northern portions of Nevada, it seems to be more common at valley bottoms (1,050 - 1,800 m).

GENERAL HABITAT AND LIFE HISTORY:

The western small-footed myotis is a crevice rooster, using mines, caves, buildings, rock crevices, hollow trees, and exfoliating bark on trees. It is found in a variety of habitats including desert scrub, grasslands, sagebrush steppe, blackbrush, greasewood, pinyon-juniper woodlands, pine-fir forests, agriculture, and urban areas. The western small-footed myotis hibernates individually or in large colonies, and in some areas may tolerate drier and colder hibernacula than some other species. This species generally crawls into small cracks and crevices during hibernation and can therefore easily be missed during surveys.

Forages early in the evening on a variety of insects including small moths, flies, ants and beetles that occur in open areas. Elsewhere in the US, this species has been documented foraging 1-3 m above the ground along cliffs and rocky slopes.

Western small-footed myotis look very similar to the California myotis which can cause confusion when identifying captured individuals. However, the two species are easily distinguished from each other acoustically.

CONSERVATION CHALLENGES:

Threats include loss of roosting habitat, permanent mine closures, recreational caving, contaminant poisoning, and disturbance during winter hibernation. Additionally, due to its habit of hibernating underground in larger groups, this species could be particularly vulnerable to white nose syndrome.

NEEDS:

Research Needs: For a seemingly common and widespread bat throughout most of Nevada, very little is known about the western small-footed myotis. Little is known about foraging behavior, reproductive biology, roosting requirements, acceptance of bat gates, and population dynamics. Information is needed on the current distribution and status of the species. Particular attention should be focused on locations and characteristics of winter hibernacula, which can be in deep, complex abandoned mines.

Monitoring and Existing Plans: Western small-footed myotis are addressed in the Nevada Bat Conservation Plan (2006).

Approach: Continue monitoring and mapping key habitat for the species, especially maternity and hibernating sites. Delineate range more precisely and initiate research to study key aspects of the species' biology. Critical roosting sites in mines and caves should be appropriately protected and all mines should be properly evaluated for wildlife use before closure. As with all bats, this species should be monitored for white-nose syndrome.

WAP HABITAT LINKS: Salt Desert Shrub, Sagebrush, Mojave Warm Desert and Mixed Desert Scrub, Aspen, Lower Montane Woodlands and Chaparral, Intermountain Coniferous Forest, Sierra Coniferous Forest and Woodlands, Cliffs and Canyons, Caves and Mines, Developed Landscapes, Agricultural Lands.

Appendix A

Eight Required Elements & Revision Guidelines for Incorporating Climate Change

The Nevada Wildlife Action Plan authoring and revision process has been guided by several documents provided to the states by a working group of U.S. Fish & Wildlife Service and Association of Fish & Wildlife Agencies staff members. These documents, as captured in the following sections, contain the requirements for the original drafting of the state Wildlife Action Plan, plan revision strategies, and guidance on integrating climate change into management plans, including the Wildlife Action Plan.

Original Eight Required Elements for State Comprehensive Wildlife Conservation Strategies (AFWA 2002)

1. Information on the distribution and abundance of species of wildlife, including low and declining populations as each State fish and wildlife agency deemed appropriate, that are indicative of the diversity and health of wildlife of the State; (In subsequent discussions, these species were referred to as Species of Greatest Conservation Need or SGCN.)

2. Information on the location and relative condition of key habitats and community types essential to the conservation of each State's SGCN;

3. Descriptions of the problems which may adversely affect SGCN or their habitats, and priority research and surveys needed to identify factors which may assist in restoration and improved conservation of SGCN and their habitats;

4. Descriptions of the actions necessary to conserve SGCN and their habitats and establishes priorities for implementing such conservation actions;

5. Descriptions of the provisions for periodic monitoring of SGCN and their habitats, for monitoring the effectiveness of conservation actions, and for adapting conservation actions as appropriate to respond to new information or changing conditions;

6. Each State's provisions to review its Strategy at intervals not to exceed ten years;

7. Each State's provisions for coordination during the development, implementation, review, and revision of its Strategy with Federal, State, and local agencies and Indian Tribes that manage significant areas of land or water within the State, or administer programs that significantly affect the conservation of species or their habitats; and

8. Each State's provisions to provide the necessary public participation in the development, revision, and implementation of its Strategy.

Guidance for Wildlife Action Plan Review and Revisions

(USFWS and AFWA, July 2007)

Purpose

The purpose of this document is to identify the process and requirements that all States/territories must utilize for the future review and revision of their Wildlife Action Plans (Action Plans).

Introduction

The Action Plans were developed by the States to be dynamic, adaptive documents that would guide agency and partner conservation planning for years to come. Each State committed to reviewing or, if necessary, revising (review/revise) their Action Plan within 10 years as per Element 6 of the original legislation. Many States committed to do so at much shorter intervals.

The U.S. Fish and Wildlife Service (USFWS), encourages States to review and revise their plans as often as is useful to them and their partners. Recent Congressional report language indicates that Congress expects the USFWS to develop guidance/standards that will be utilized by all States/territories to revise their action plans. The Congress also expects that USFWS will apply the standards consistently in all Regions. (cf. Senate Report 109-275: Department of the Interior, Environment, and Related Agencies Appropriations Bill, 2007. House Report 109-465: Department of the Interior, Environment, and Related Agencies Appropriations Bill, 2007). This guidance document will ensure national consistency while allowing States and their partners' flexibility to update their Action Plans without undue burden.

Review Process

Original plan review, with approval recommendations to the Director of the USFWS was provided by a National Advisory Acceptance Team (NAAT) -- the Assistant Director of Wildlife and Sport Fish Restoration, each of the seven USFWS Assistant 2 Regional Directors for Migratory Birds and State Programs (ARD), Assistant Manager (AM) of the California/Nevada Office, a representative State Director from each regional Association of Fish and Wildlife Agencies (AFWA), and a representative of the national AFWA organization. Although a NAAT may be reconvened in the future to consider general policy matters or particularly complex review/revision issues, it is not anticipated that a NAAT will evaluate Action Plan review/revisions. Instead, that task will be accomplished by Regional Review Teams (RRTs). The RRTs were an integral part of the original Action Plan evaluation process and we feel that future evaluations of Action Plan review/revisions will be carried out more effectively using this regional approach.

There will be eight RRTs, one within each FWS region. The RRTs are comprised of one ARD, AM or equivalent; and one State Director appointed by each of the four regional associations (e.g. Southeastern, Midwest, Northeast, and Western). State Directors serving on RRTs will not evaluate the Action Plan from their own agency. In such cases, the Action Plan would be sent to another RRT for review. Federal Assistance Program and State staff may assist the RRTs as necessary. RRTs will assist States with guidance on Action Plan revisions and be available for any Action Plan related issues that may arise

General Requirements

All States must review/revise their Action Plans by October 1, 2015, or the date specified in their original, approved Action Plan and send the updated version and summary documentation to the USFWS. This summary documentation must demonstrate that the entire Action Plan was examined and that all of the original Eight Required Elements (attached) were met, including an up-to-date public review process specified in Elements 7 and 8. If no changes were made, the State must document and explain why no changes were necessary and what process was used to make that determination. For more details, see Section A. Once Action Plan review/revisions are approved, States are not obligated to review/revise their Action Plans for another 10 years or until a date specified in the Action Plan. A State may also revise only a part of its Action Plan without reviewing/revising its entire Action Plan. Some Action Plan revisions, including but not limited to the addition of a species, are defined as "major" (see definition on page 5). As such, States must provide documentation that demonstrates all of the original Eight Required Elements are adequately addressed, including an up-to-date public review process as specified in Elements 7 and 8. "Major" revisions must follow the requirements outlined in Section B. All other revisions are considered "minor" and must follow the requirements outlined in Section C.

Specific Requirements

Section A.

Requirements for Planned Review/Revision of Entire Plan

(1) State agency director notifies its Regional USFWS Federal Assistance office by letter of intent to review or revise the Action Plan.

(2) State and USFWS meet to discuss guidance to ensure all elements will be addressed prior to submission of documentation and reviewed/revised Action Plan.

(3) State submits reviewed/revised Action Plan package by October 1, 2015, or the date specified in its original, approved Action Plan to the Regional Federal Assistance office.

This package will include:

- summary of any significant changes and documentation describing how the current version of Action Plan adequately addresses the Required Eight Elements, including an up-to-date public review process specified in Elements 7 and 8;
- "Road map" (summary of location of elements in document) to locate revisions in Action Plan.

(4) States are encouraged to post an electronic version of their most recent Action Plan on the web along with the summary of significant changes and "road map."

(5) RRT reviews Action Plan with input from Federal Assistance staff and determines whether it is approvable or not approvable. The ARD or AM will send a letter to the State Director with documentation of the decision and description of any required action if the Action Plan is not approvable. State Directors can appeal to the Regional Director.

(6) ARDs and AM are responsible for communicating significant issues with members of all the RRTs to ensure consistency among RRTs.

(7) States that specified a review/revision within 10 years (prior to the October 1, 2015, deadline) in their Action Plan and wish to change that date must submit a "minor" revision letter (see Section C below) to their Regional Federal Assistance office.

(8) Federal Assistance must track revisions and due dates and maintain an administrative record of Action Plan revisions.

Section B.

Requirements for "Major" Revisions Prior to the Planned Review/Revision Date

(1) State agency director notifies its Regional FWS Federal Assistance office by letter of intent to make "major" revisions to the Action Plan (See definition below).

(2) State submits modified Action Plan and includes:
- summary of all significant revisions;
- documentation describing how the revision meets the Required Eight Elements, including an up-to-date public review process specified in Elements 7 and 8;
- "road map" to locate revisions in Action Plan.

(3) States are encouraged to post an electronic version of their most recent Action Plan on the Web with the summary of significant changes and "road map."

(4) RRT reviews Action Plan with input from Federal Assistance staff and determines whether it is approvable or not approvable. The ARD or AM will send a letter to the State Director with documentation of the decision and description of any required action if the Action Plan is not approvable. State Directors can appeal to the Regional Director.

(5) ARDs and AM are responsible for communicating significant issues with members of all the RRTs to ensure consistency among RRTs.

(6) Federal Assistance must track these revisions and maintain an administrative record of Action Plan revisions.

Section C.

Requirements for "Minor" Revisions Prior to the Planned Review/Revision Date

(1) State Director notifies the Regional FWS Federal Assistance office by letter of intent to make minor revisions with a description of the change and why the change is considered a minor revision.

(2) State submits letter that includes:
- summary of all revisions;
- "road map" to locate revisions in Action Plan.

(3) States are encouraged to post an electronic version of their most recent Action Plan on the web along with the summary of significant changes and "road map" (summary of location of elements in document).

(4) Federal Assistance must track these revisions and maintain an administrative record of Action Plan revisions.

Definitions

"Major": A significant change or changes that requires revision of two or more elements in the Action Plan. Any addition of a species of greatest conservation need (SGCN) would be a major revision. This is considered a major revision because it would require the State to substantially address subsequent elements (i.e., habitats, threats, actions). Similarly, a revision of its threat assessments for SGCN species and/or habitats that are essential to conservation of SGCN would be a major change because it would likely result in changes to conservation actions and prioritization of those conservation actions.

"Minor": All revisions not considered "major".

The RRT will determine if a change is minor or major when it is unclear. This decision may be requested by either the State or staff of Federal Assistance. State Directors can appeal decisions to the Regional Director.

Note that States and other eligible jurisdictions that wish to use State Wildlife Grant (SWG) funds to address critical priority issues not identified within an Action Plan should refer to the USFWS *2007 Administrative Guidelines for State Wildlife Grants* (SWG Guidelines)*, Section X.H*.

Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans (Excerpted from AFWA 2009)

This chapter includes a review and summary of existing guidance on Wildlife Action Plans and describes how climate change may reshape the original eight required elements. Congress required that state fish and wildlife agencies develop a Wildlife Action Plan as a condition for receiving State Wildlife Grant funding. The U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies have provided guidance on the development, approval, implementation and revision of Wildlife Action Plans and the expenditure of State Wildlife Grant funds to assist states in carrying out this mandate. The most recent guidance was a letter by the Director of the US Fish and Wildlife Service and the President of the Association of Fish and Wildlife Agencies regarding requirements for plan revision (2007 FWS/AFWA Revision Guidance Letter). Additional guidance may be included in future appropriation or climate change legislation. States should review their Wildlife Action Plans to determine the timeframe for required revisions. States may opt to revise their plan before they are required to do so.

Existing Guidance Documents That Were Reviewed:

1. Congressional Legislation – Required 8 Elements (2000)
2. AFWA Guiding Principles White Paper (2002)
3. AFWA Guidance Binder (2003)
4. NAAT One Year Out Guidance (2004)
5. FWS/AFWA Revision Guidance Letter (2007)
6. Draft 2 521 FWS State Wildlife Grant Chapter (2007)

Wildlife Action Plans were organized according to eight elements required by Congress. Each of these required elements must be addressed during a major revision of a Wildlife Action Plan. Following is a review of the eight required elements and suggestions to consider when revising your Wildlife Action Plans to better incorporate climate change:

Climate Change Implications by Element

<u>Element 1:</u> *Information on the distribution and abundance of species of wildlife, including low and declining populations as the state fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the state's wildlife.*

According to the *AFWA Guiding Principles White Paper (2002)*, Wildlife Action Plans should address the broad range of wildlife and associated habitats, as well as combine landscape/ecosystem/habitat-based approaches and smaller-scale approaches (e.g. focal, keystone, and/or indicator species; guilds; species of special concern) for planning and implementation. The *AFWA Guidance Binder (2003)* provides specific criteria for the evaluation of species for inclusion as a species in greatest need of conservation. Many of those criteria may need to be reevaluated in the context of climate change, including criteria for the following categories: globally rare species; declining species; endemic species; disjunct species; vulnerable species; small, localized populations; species with limited dispersal; species with fragmented or isolated populations; species of special conservation concern; focal species; keystone species; wide ranging species; species with specific needs; indicator species; responsibility species (i.e. species that have their center of range within a state) and species that rely on concentration areas (e.g. migratory stopover sites, bat roosts/maternity sites). The evaluation should describe how and why a state's species in greatest conservation need (SGCN) list priorities will change as a result of the evaluation.

Climate Change Considerations:

- States should consider reexamining their SGCN list and make changes to account for current and future impacts of climate change. It may be necessary to specifically examine the likely effects of climate change on species with very low and declining populations. Climate change may significantly change the abundance of many wildlife species (including species which were not considered to be SGCN).

- States should consider the implications for range changes in recovery efforts of SGCN species. Climate change may significantly change the distribution of many wildlife species (including species not currently considered SGCN).

- States may need to reconsider their definitions/lists for native, exotic and invasive species.

- State's should consider using their revision process as an opportunity to address the needs of species groups not currently addressed in their Wildlife Action Plan (e.g. marine species, plants). If there are jurisdictional barriers states may want to show how those species are being addressed by other agencies of jurisdiction.

- States should consider using vulnerability assessments as a tool for identifying and describing the impacts of climate change on species. Vulnerability assessments can help states plan for new threats associated with climate change and those that might be exacerbated by climate change.

- States should consider using species-based models that can incorporate both direct and indirect effects of climate change on survival, reproduction and other life history factors. For example temperature changes may lead to increased severe weather events that affect survival or reproductive capacity of migratory species.

- States should consider using vulnerability assessments to consider how climate change influences populations outside of a state's border.

Element 2: *Information on the location and relative condition of key habitats and community types essential to the conservation of each state's SGCN.*

Revision of Element 2 for climate change should address the broad range of habitats associated with SGCN. Both landscape and smaller scale approaches should be considered (AFWA Guiding Principles White Paper, 2002). Spatially explicit information such as GIS-produced maps can be a useful tool for describing habitat conditions and location and can be used by the agency and partners to guide conservation work and inform land-use decision-making (AFWA Guiding Principles 2002). If possible, the revision process should consider habitats/biotic communities that serve as "umbrellas" for species assemblages. A habitat/vegetation approach can improve efficiency in managing for multiple species and serve as a way to conserve all species, including common and game species (AFWA Guidance Binder, 2003). Climate change revisions should consider the scale required for effective conservation of habitats in the face of a changing climate and suggest coordination processes for conservation at effective scales (NAAT One Year Out Guidance, 2004).

Climate Change Considerations:

- States should consider acquiring information on how habitats and communities are likely to change as a result of climate change (i.e. use scenario-building processes).

- States should consider how climate change will affect the future abundance and distribution of habitat types as well as changes in structure and physical characteristics.

- States should consider the implications of the appearance of novel (no-analog) communities as vegetation responds to changing climate.

- States should strive to identify the location and condition of priority landscapes and smaller site-specific habitats that may not be easily mapped but are important now or in the future to SGCN (e.g. seasonal habitats).

- States should consider that climate change will likely affect the extent and condition of habitats and community types at various spatial and temporal scales.

- States should consider using vulnerability assessments as a tool for identifying and describing the impacts of climate change on key habitats.

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

Revision of Element 3 will require that states examine the full range of issues, including non-wildlife factors that have substantial impact on wildlife conservation (AFWA Guiding Principles White Paper, 2002). Wildlife Action Plans should address issues at the state level and coordinate with parallel efforts in other states and countries (AFWA Guiding Principles White Paper, 2002). Threats analyses (or other comparable methodology) should be used to set goals and priorities and should identify knowledge gaps for future study (AFWA Guiding Principles 2002).

Climate Change Considerations:

- States should consider climate change as a new problem for species and habitats, including potential direct and indirect impacts (e.g. sea level rise, invasive species, disease, snowpack extent and duration and increased number and severity of floods, droughts and wildfires).

- States should consider reviewing current threats, problems, or impacts affecting wildlife through a climate lens and treat climate change as both a new and exacerbating threat.

- States should consider using vulnerability assessments to identify and prioritize threats.

- States should consider the impacts of fragmentation and land use to fish and wildlife movement as a barrier to wildlife adaptation across the landscape.

- States should consider using methodology that "steps down" global climate models to the state level so that the impacts of climate change can be better understood at scales that are useful for decision-making and management at the state scale.

- States should consider partnering with adjacent states or regions to identify and implement priority research and survey needs both within and across state border.

- States should consider using research and monitoring to identify how habitats or plant communities may change in response to climate change and how those changes influence conservation of SGCN.

- States should consider using research to understand which vital rates or life history characteristics are influenced by climate change (survival, reproductive capacity, foraging, etc.).

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

Revision of Element 4 will require that states describe the conservation actions needed to address identified threats to SGCN and their habitats. Identification and prioritization of actions should involve all relevant partners and consider various approaches at appropriate state, regional and national scales (AFWA Guiding Principles White Paper, 2002). Actions should make full use of existing information, identify knowledge gaps and incorporate techniques such as vulnerability assessments to set priorities (AFWA Guiding Principles White Paper, 2002). Wildlife Action Plans should be a driving force in guiding activities under diverse wildlife and habitat conservation initiatives and should include all needed actions regardless of funding source or state wildlife agency capacity (AFWA Guiding Principles White Paper, 2002; NAAT One Year Out Guidance, 2004). Conservation actions should be described sufficiently to guide implementation of those actions through development and execution of specific projects and programs.

Climate Change Considerations:

- States should consider developing conservation actions that specifically address the direct and indirect impacts of climate change on species and their habitats over a wide range of likely future climate conditions.

- States should consider identifying/describing how conservation actions will be prioritized in consideration of multiple threats/stresses and increased uncertainty.

- States should consider identifying which actions are intended to minimize climate change impacts, which will provide for wildlife adaptation, which will provide for resilience and/or which will facilitate movement to suitable habitats and conditions.

- States should consider identifying decision points or thresholds for actions that are designed to: 1) recognize that some species will go extinct despite our best efforts; and 2) minimize imminent loss of habitats and species.

- States should consider including the identification, protection and maintenance of key corridors to improve connectivity as a key action to help wildlife adapt to climate change.

- States should consider linking conservation actions to specific objectives and indicators that will facilitate monitoring, performance measurement and changes or improvements to actions through adaptive management.
- States should consider conservation actions that benefit the greatest number of SGCN and other more common and economically important species (e.g. game species).

Element 5: *Descriptions of the proposed plans for monitoring species identified in Element 1 and their habitats, for monitoring the effectiveness of the conservation actions proposed in Element 4, and for adapting these conservation actions to respond appropriately to new information or changing conditions.*

Revision of Element 5 will require that states identify proposed monitoring plans. When developing or adapting monitoring efforts for incorporation of climate change, states should base their Wildlife Action Plans in the principles of “best science,” “best management practices,” and “adaptive management,” with measurable goals, objectives, strategies, approaches and activities that are complete, realistic, feasible, logical and achievable (AFWA’s Guiding Principles White Paper, 2002). Wildlife Action Plans should describe the proposed plans for monitoring species and their habitats and the effectiveness of the conservation actions taken, with attention given to adapting conservation actions to new information and changing conditions (AFWA Guidance Binder 2003). While all states addressed and included monitoring plans in their approved Wildlife Action Plans, most did not address or include monitoring specifically for climate change impacts or adaptation. States should consider how existing monitoring plans can or should be modified to address climate change or if climate change monitoring should be considered independently.

Climate Change Considerations:
- States should consider increasing monitoring effort to better inform adaptive management, which is of increased importance in responding to climate change.

- States should consider increasing monitoring effort to evaluate management decisions which will become increasingly complex because of the uncertainty of climate change.

- States should strive to use the most streamlined, affordable, scalable and broadly applicable monitoring methods available.

- States should consider new collaborations with other states, NGO’s, citizen scientist organizations etc. to improve species and habitat monitoring across entire ranges and regions.

<u>Element 6:</u> *Each State's provisions to review its strategy at intervals not to exceed ten years.*

Revision of Element 6 will require that states identify the timeframe for future plan revisions. The *AFWA Guiding Principles White Paper, 2002* recommended that Wildlife Action Plans include review procedures that ensure the plans are dynamic and can be improved and updated efficiently as new information is obtained. The *NAAT One Year Out Guidance (2004)* states that additions and changes to Wildlife Action Plans should be identified as part of the "element guide" and where appropriate demonstrates the linkages between changes in the elements. For example, a change in the SGCN list (Element 1) might require reprioritization of the actions necessary to conserve species and/or their habitats (Element 2). According to the FWS/AFWA Revision Guidance Letter (2007) all states should review/revise their Action Plans by October 1, 2015, or by the date specified in their approved Action Plan. Many states are currently revising their Wildlife Action Plan or may be doing so in the future to better incorporate climate change.

The *FWS/AFWA Revision Guidance Letter (2007)* instructs that states contact their Wildlife and Sport Fish Restoration State Wildlife Grant Specialist in their USFWS regional office for guidance at the outset of their revision process. If a state included only a brief mention of climate change, then the state may make a request of the Service to include climate change as an emerging issue. The request should be made as a letter to the U.S. Fish and Wildlife Service describing the emerging issue and committing the state to a thorough discussion of the climate change in the next scheduled revision of their Wildlife Action Plan. States planning to revise their Wildlife Action Plans to more fully incorporate climate change should refer to the *FWS/AFWA Revision Guidance Letter (2007)* in the Appendix to determine if a revision will be considered "major" or "minor" and to ensure the proper steps are followed.

<u>Element 7:</u> *Each State's provisions for coordination during the development, implementation, review, and revision of its Strategy with Federal, State, and local agencies and Indian Tribes that manage significant areas of land or water within the State, or administer programs that significantly affect the conservation of species or their habitats.*

Revision of Element 7 will require that states describe how they will coordinate with partner organizations. Coordination is encouraged, especially for border states and states where such coordination is needed for successful conservation of SGCN (NAAT One Year Out Guidance, 2004). Many efforts are underway by state agencies, federal agencies and private conservation organizations to plan for climate change. In addition, there is rapid growth in the volume of information becoming available about climate change including vulnerability assessment, wildlife adaptation and research and monitoring. Coordination with partners will help ensure that state fish and wildlife agencies can use and distribute information on climate change in an efficient and effective manner.

Climate Change Considerations:

- States should consider involving/collaborating with partners (e.g. agencies, private conservation organizations, tribes, etc.) early during the revision process to ensure effective communication and sharing of information, expertise and resources.

- States should consider involving/coordinating with partners due to the uncertainty of climate change and the importance of coordinating management at large ecologically meaningful scales.

- States with coastal resources should consider collaborating with marine-oriented partners, particularly those states without full jurisdiction over marine species.

Element 8: *Each State's provisions to provide the necessary public participation in the development, revision, and implementation of its Strategy.*

Public participation is the process of inviting and involving the public in decision-making to promote trust, accountability and transparency. It serves the public interest, can lead to improved decision-making and helps to identify and recruit new constituencies. Public participation is a discipline and there are many sources of information, training, expertise and case studies available to assist with the process.

Public participation can be accomplished through advisory committees, public meetings, town halls, forums, polling, open houses, workshops, focus groups public comment periods, social networking, etc. The International Association of Public Participation is a good source of information and their public participation spectrum can help categorize major stakeholder roles in the public participation process. AFWA's Guiding Principles White Paper (2002) made a number of recommendations related to public participation including the importance of documenting decision points, involving partners early in the process and using traditional (e.g. public meetings) and technological innovations (e.g. internet polling) to engage the public. The Plan Revision Guidance Letter (2007) stated that "a major revision of a Wildlife Action Plan will require that states address element eight and provide an up to date public review process." The letter also stated that "states are encouraged to post an electronic version of their most recent Action Plan on the web along with the summary of significant changes and "road map."

The AFWA Guidance Binder (2003), made the following suggestions related to public participation. Agency capacity for leading a public participation process should be assessed and those leading the process should be experienced and well trained. Where capacity is lacking, professionals outside the agency should be utilized. Objectives for public involvement should be determined during the early stages of planning and be based on agency and public needs or requirements. These needs or requirements may change over time, which may require a change in objectives. It is important to anticipate controversies so relevant information can be acquired in advance of public meetings. Potential triggers can be defused by framing the planning process in terms that reduce the risks of public misunderstanding or intentional misrepresentation. The plan's purposes should be linked to established community values (e.g. bird watching, fishing, economic development, quality of life), existing conservation efforts should be acknowledged and the voluntary nature of the plan should be emphasized. Language should be direct and honest and it should be understood that the most involved or outspoken people may be opinion leaders but may not be indicative of the public at large. Including such people in the process is essential, but their viewpoints should be corroborated. Past experiences in public participation (good and bad) can serve as a guide for new processes.

Climate Change Considerations:

- States should consider using public participation planning processes because of the complexity and potential for controversy associated with climate change.

- States should take advantage of resources (e.g. PowerPoint presentations) available from states and partners that can useful in helping the public understand the science and impacts of climate change on wildlife.

- States should recognize that there are a variety of positions on climate change even among those who value wildlife. Controversy associated with policies to reduce greenhouse gasses (e.g. cap and trade protocol) should be separated from the necessity to immediately address the impacts of climate change to wildlife.

- States should consider choosing terms that are appropriate and if possible tested with your constituency groups. For example, the term “safeguarding wildlife” has been shown to be more readily understood by the public than “adaptation”.

- States should consider involving conservation partners early during the public participation planning process, but recognize there may not be agreement on messages or approaches.

References

Eight Required Elements for State Wildlife Action Plans. Association of Fish & Wildlife Agencies. 2002. http://www.wildlifeactionplans.org/pdfs/eight_elements_handout.pdf

Guidance for Wildlife Action Plan (Comprehensive Wildlife Conservation Strategy) Review and Revisions. U.S. Fish & Wildlife Service and Association of Fish & Wildlife Agencies. July 2007. http://wsfrprograms.fws.gov/subpages/toolkitfiles/NAATgde.pdf

Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans & Other Management Plans. Association of Fish & Wildlife Agencies. September 2009. http://www.fishwildlife.org/files/AFWA-Voluntary-Guidance-Incorporating-Climate-Change_SWAP.pdf

APPENDIX B

MANAGEMENT OF WILDLIFE RESOURCES IN NEVADA

Nevada Department of Wildlife

The Mission of the Nevada Department of Wildlife (NDOW) is to protect, preserve, manage and restore wildlife and its habitat for their aesthetic, scientific, educational, recreational and economic benefits to citizens of Nevada and the United States, and to promote the safety of persons using vessels on the waters of this state. The Department of Wildlife is commissioned in NRS 501.331 to "administer the wildlife laws of this state and chapter 488 of NRS (boating law)." A director is appointed by the governor to carry out the policies and regulations of the Commission, and direct the activities and programs of the Department. NDOW facilities include a headquarters office, 3 regional offices and 27 field offices that house the functions of agency management, information and education, public service, air operations and radio dispatch communications. The total staff consists of 243 full time personnel. www.ndow.org

Wildlife Management Areas

There are 11 Wildlife Management Areas (WMAs) in Nevada, encompassing approximately 48,560 hectares (120,000 acres) of wildlife habitat. These areas are home to many resident and migratory birds, mammals, fish and amphibians. Located throughout the state, the public can generally drive to a WMA in less than two hours from the major population centers and find great access to wildlife viewing. The primary management emphasis on most WMAs is the protection of wetlands and migratory birds including the use of the areas as public hunting grounds. WMAs also provide important sport fishing and wildlife watching opportunities, and several WMAs provide essential habitat and conservation opportunities for numerous SOCP species. Hunting opportunities on WMAs include migratory game bird, upland game bird, furbearer, and big game hunting. http://www.ndow.org/wild/habitat/wma/

- The *Alkali Lake WMA*, located in Lyon County about 16 km (10 miles) southwest of Yerington, encompasses 1,395 hectares (3,450 acres) and lies in and adjacent to a small natural sink at the south end of Smith Valley. The WMA can provide 1,215 hectares (3,000 acres) of wetland habitat during wet years, however during most years, the area is dry. Waterfowl are the most common wildlife on the area, but those numbers fluctuate dramatically in response to water availability. Waterfowl hunting and wildlife viewing are popular activities.

- *Bruneau River WMA* is located in Elko County about 130 km (80 miles) north of Elko and 13 km (10 miles) south of the Idaho border. The WMA totals 1,930 hectares (4,770 acres) and includes the Bruneau River and Meadow Creek drainages. Numerous wildlife species including Greater Sage-Grouse, Blue Grouse, redband trout, mule deer and a wide variety of raptors, passerines, and reptiles benefit from the mosaic of habitats in the area. Primary recreational uses of the WMA are hunting, fishing, camping and wildlife viewing.

- *Fernley WMA* is located in Lyon County, about 5 km (3 miles) east of the city of Fernley. The area consists of 5,270 hectares (13,020 acres) including seasonally flooded alkali flats, wet meadow and desert riparian habitats, and desert shrublands of greasewood and shadscale. During wet years, this area provides habitat for migratory and nesting waterfowl and other wetland-dependent wildlife. Waterfowl hunting is the primary recreational use of the area.

- *Franklin Lake WMA*, located 105 km (65 miles) southeast of Elko in Elko County, includes 1,305 hectares (3,230 acres) of wetlands within the Ruby Lake-Franklin Lake ecosystem. The Franklin Lake wetlands are a natural, unaltered ecosystem fed by over 25 small streams flowing out of the Ruby Mountains. Water levels are dependent on snow pack in the Rubies and annual rainfall in the Ruby Valley. Franklin Lake provides important migratory and breeding habitat for waterfowl, shorebirds, wading birds, Sandhill Cranes and numerous other species. Waterfowl hunting and wildlife viewing are the most common recreational pursuits in the area.

- *Humboldt WMA* located in Pershing and Churchill counties, totals 15,030 hectares (37,140 acres) and is about 30 km (20 miles) southwest of Lovelock and 130 km (80 miles) east of Reno. The WMA lies at the terminus of the Humboldt River, which serves as the major source of water for the area. Wetlands and aquatic habitats comprise 11,290 hectares (27,900 acres) of the area. During wet years, the area contains very large expanses of water which attracts a vast array of waterfowl, shorebirds and wading birds to the shallow water habitat. Waterfowl hunting and wildlife viewing are the major recreational uses of the area.

- *Key Pittman WMA* is located in Lincoln County at the north end of the Pahranagat Valley, about 220 km (135 miles) south of Ely. Nesbitt and Frenchy lakes, totaling about 200 hectares (500 acres), are located on the WMA. Adjacent to the lakes are marshes and agricultural cropland surrounded by uplands. The fish and wildlife resources of the area are very diverse due to the mosaic of habitat types found on the WMA. Waterfowl, wading birds, shorebirds, passerines and numerous other wildlife species benefit from the project and the WMA provides important habitat for several SOCP species. Waterfowl hunting, fishing and wildlife viewing are popular recreational uses of the area.

- *Mason Valley WMA,* in Lyon County, consists of approximately 5,415 hectares (13,375 acres) of desert shrub lands and wet meadows supporting an abundance of fish and wildlife. The Walker River floodplain meanders through Mason Valley WMA, providing food, cover and water for a vast array of wildlife. Numerous wet meadows and ponds dot the landscape, attracting ducks, geese, swans, songbirds and wading birds. The deep-water habitat of the newly constructed North Pond reservoir is home to fish, Osprey and American White Pelicans. Alkali desert scrub, an upland plant community, covers an extensive area of Mason Valley WMA and provides shelter to many mammals including raccoon and mule deer. A wide variety of hunting, fishing and wildlife viewing opportunities occur in the Mason Valley WMA.

- *Overton WMA* lies in the lower extremes of the Moapa and Virgin River valleys in Clark County, where they flow into the north end of the Overton Arm of Lake Mead. Located in the Mojave Desert, Overton WMA supports an abundance of fish and wildlife. Desert riparian habitat, associated with the floodplain of the Muddy and Virgin rivers, is extremely important to wildlife populations. The dense shrubbery of desert wash habitat provides food and shelter for small mammals and many species of birds. Numerous wet meadows and ponds dot the landscape, providing food, cover, and water for birds, mammals, reptiles, and amphibians. The deep water of Lake Mead provides habitat for fish, cormorants, and diving ducks, while shallow littoral zones provide feeding areas for puddle ducks and shorebirds.

- *Scripps WMA* in Washoe County consists of about 965 hectares (2,380 acres) and includes the north end of Big Washoe Lake and the marshes south of Little Washoe Lake in Washoe Valley. The uplands surrounding the wetland areas are primarily sagebrush and desert shrub lands. Waterfowl hunting, fishing and wildlife viewing are popular recreational pastimes of the area. The WMA provides an important opportunity for residents of Reno, Sparks and Carson City to enjoy wetland-associated wildlife within close proximity to their homes.

- *Steptoe Valley WMA* located just south of Ely in White Pine County consists of 2,600 hectares (6,425 acres), plus an additional 11,050 hectares (27,305 acres) of grazing allotments associated with the base property. From wet meadows and riparian corridors to sagebrush and piñon-juniper uplands, the habitats of Steptoe Valley WMA support an abundance of fish and wildlife. Sagebrush is important habitat for mule deer, pronghorn, sage grouse and a multitude of nongame species. Piñon-juniper habitats are present on the uplands surrounding the Steptoe Creek drainage. The riparian habitats of Steptoe Valley include cottonwood, willow, and aspen. Various ponds and wet meadows dot the landscape, providing food, cover, and water for numerous species of waterfowl, wading birds, and mammals. The deep water of Comins Lake provides habitat for fish and diving ducks.

- *Wayne E. Kirch WMA* is located in the White River Valley in northeastern Nye County. From sagebrush to wet meadows and grasslands, the Kirch WMA supports an abundance of fish and wildlife. The White River bisects the area and provides wetlands and deep water habitats. Uplands in Kirch WMA include sagebrush, alkali desert scrub, annual grassland and desert wash. Sagebrush provides important habitat for mule deer, pronghorn, sage grouse and nongame species. The desert wash habitat is found in narrow corridors around intermittent streams carrying runoff from the Egan Range into the White River Valley. Springs and spring outflows on Kirch WMA provide essential habitat for several native aquatic SOCP species including Nevada's first Native Fish Refuge site at Hot Creek, designated in 1969. The reservoirs on Kirch WMA provide important sport fishing resources and habitats for diving ducks, puddle ducks, and shorebirds.

Hatcheries

The Mission of the NDOW hatchery program is to rear and stock fish into Nevada waters for their scientific, educational, recreational, and economic benefits to the citizens of Nevada. NDOW administers three fish hatcheries and one rearing station that annually raise 2.2 million fish for stocking into 36 streams and rivers, and 61 lakes, reservoirs and ponds. http://www.ndow.org/fish/stocking/hatch/

- Located on the Ruby Valley National Wildlife Refuge, *Gallagher Hatchery* produces approximately 100,000 pounds of trout each year. The most common trout raised at Gallagher is rainbow, but brown, brook and occasionally hybrid trout are also reared there. Operations at Gallagher are unique to the rest of Nevada's hatchery system in that rainbow and brown trout broodstock are maintained to assist in annual egg production needs.

- *Spring Creek Rearing Station*, located near the town of Baker, receives predominantly rainbow trout at a fingerling size and raises them to a catchable length for planting. Originally constructed in 1949, Spring Creek Rearing Station produces about 35,000 pounds of trout annually.

- Constructed in 1990, *Mason Valley Hatchery* is located within the Mason Valley WMA, near Yerington, Nevada. This facility raises a variety of trout, including brook, brown, cutthroat, tiger and several strains of rainbow. Total production from this hatchery is approximately 150,000 pounds of trout per year.

- The reconstruction of Lake Mead Hatchery, on the western shore of Lake Mead, was completed in 2005. NDOW's newest hatchery was intended to provide a state-of-the-art facility for the rearing of up to 180,000 pounds of rainbow trout annually, for stocking in southern Nevada and other locations in the State. Unfortunately, the subsequent detection of invasive quagga mussels in Lake Mead combined with high water temperatures from low Lake Mead storage levels has precluded trout production for the immediate future and trout rearing activities were suspended in 2007 until a practical solution to these problems could be found. Funding provided by native fish programs has allowed limited rearing of certain Nevada native fish species such as razorback suckers which can tolerate warmer water temperatures, for release into the Colorado River system.

Partners for Conservation and Development

The Nevada Partners for Conservation and Development (NPCD) was formed in 2010 to provide leadership and a forum for collaborative, landscape scale and scientifically based habitat restoration program in Nevada. The NPCD established a process for project development with a "ground-up" approach and focus on local partners, as modeled by the Utah Partners for Conservation and Development group. This model provides strong evidence that working in a genuinely collaborative and cross boundary fashion will show results in the form of increasingly healthy habitat and the ability to respond to large ecological problems.

Funding for Wildlife Conservation on Private Lands

- ***NDOW Landowner Incentive Program (LIP)***

The primary objective of LIP is to protect and restore habitats on private lands to benefit Species of Conservation Priority; those species which are federally listed, proposed, or candidate species as well as other species determined to be at risk. The LIP program provides technical and financial assistance to private landowners for habitat protection and restoration. http://www.ndow.org/wild/conservation/lip/

- ***Question 1 – Nevada's Conservation Bond***

In 2002, Nevadans voted and passed the $200 million Question 1 Bond Initiative, authorizing the state to issue bonds for projects to protect and preserve natural resources in Nevada. NDOW received $27.5 million for the acquisition of property to enhance, protect, and manage wildlife and wildlife habitat, or enhance recreational opportunities related to wildlife, for the development and renovation of facilities and the improvement of existing habitats for fish and other wildlife.

Through the Question 1 Bond Initiative funding, NDOW and partners have undertaken several conservation-based planning projects that have expanded the scientific understanding of some of Nevada's habitat and species or increased protections of wildlife and habitat through the implementation of strategic actions. These projects include the Nevada Springs Conservation Plan, Nevada Comprehensive Bird Conservation Plan, Bird Habitat Conservation through County Planning, and the Wildlife Action Plan Revision with climate change analyses.

Nevada's Wildlife Conservation Partners

The following list of agencies and organizations represents our best attempt to inventory all the entities that have participated in the mission of wildlife conservation in Nevada, currently maintain responsibility for or interest in wildlife conservation, and are expected to continue to do so.

Federal Agencies

U.S. Fish and Wildlife Service (USFWS)

U.S. Fish & Wildlife Service is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. In Nevada, the Fish and Wildlife Service focuses its efforts in three primary program areas: Ecological Services, Fisheries, and National Wildlife Refuges. Nevada also receives technical assistance from their regional office programs, most notably the Office of Migratory Bird Management. http://www.fws.gov/nevada/

- ***Ecological Services Program***

This program provides technical assistance and project funding in three basic subject areas – endangered species, habitat conservation, and environmental contaminants. The staff assesses species and habitat status, threats, and conservation needs; and work in partnership with others to develop species management and recovery plans, conservation strategies and agreements, species listing packages and petition responses. The Fish and Wildlife Service also offers a variety of private landowner conservation tools and funding opportunities. Safe Harbor Agreements provide benefits for listed species while also providing regulatory assurances to landowners. Candidate Conservation Agreements with Assurances provide incentives for non-Federal landowners to conserve species that are candidates for listing under the Endangered Species Act. The Partners for Fish and Wildlife program offers cost-share grant funding to landowners for managing and restoring habitats on their private lands.

- ***Fisheries***

This program maintains partnerships with States, Tribes, Federal agencies, other USFWS programs, and private interests in a larger effort to conserve fish and other aquatic resources in Nevada. The Lahontan National Fish Hatchery Complex is an integrated fishery program that includes the Nevada Fishery Resource Office, Lahontan National Fish Hatchery (NFH), and Marble Bluff Fish Passage Facility. The program encompasses nearly all fishery program activities including fish passage, production and tagging programs, in-stream flow management, strain evaluation, and habitat restoration. Lahontan NFH houses an important broodstock of the original Pyramid Lake strain of Lahontan cutthroat trout that will be critical for re-establishing wild populations of Lahontan cutthroat trout to the Pyramid/Truckee River and Walker Lake basins.

- ***National Wildlife Refuges (NWRs)***

The Fish and Wildlife Service administers about 890,310 hectares (2.2 million acres) of land on nine wildlife refuges in Nevada. These lands are managed primarily for their fish, wildlife, and habitat values although other compatible uses may also occur there.

Desert National Wildlife Refuge Complex includes four refuges in southern Nevada – Ash Meadows, Desert Range, Moapa Valley, and Pahranagat. http://www.fws.gov/desertcomplex/

- *Ash Meadows NWR*, located in the Amargosa Valley of southern Nye County, consists of over 9,310 hectares (23,000 acres) of spring-fed wetlands and alkaline desert uplands providing habitat for at least 24 plants and animals found nowhere else in the world. Ash Meadows has a greater concentration of endemic species than any other local area in the United States and the second greatest in all of North America.

- *Desert National Wildlife Range*, the largest National Wildlife Refuge in the lower 48 states, encompasses 607,000 hectares (1.5 million acres) of Mojave Desert habitats and ecological communities in southern Nevada. The Refuge contains six major mountain ranges, the highest rising from 750 m (2,500-foot) valleys to nearly 3,050 m (10,000 feet). Management of desert bighorn sheep and their habitat is the most important objective of the range, although the refuge also provides habitat for the diversity of Mojave Desert wildlife.

- *Moapa Valley NWR*, located in northeastern Clark County, was established to protect the endangered Moapa dace, a small endemic fish present only in the headwaters of the Muddy River system. Dace habitat on the refuge consists of stream channels supported by six thermal springs.

- *Pahranagat NWR* is located in Lincoln County. The Refuge provides habitat for migratory birds, especially waterfowl. Pahranagat's water originates from large springs to the north of the refuge. The wetland habitats of Pahranagat support a variety of plant species favored as food by over 230 species of migratory birds and other resident wildlife. The refuge has four main water impoundments.

Ruby Lake NWR, located in extreme southeastern Elko County and northern White Pine County, consists of 15,230 hectares (37,630 acres) of marsh, meadow, and sagebrush habitat. It lies in a closed drainage basin along the eastern flank of the rugged and scenic Ruby Mountains. Ruby Lake NWR is an important nesting area for a variety of ducks and water birds. http://www.fws.gov/rubylake/

Sheldon NWR, located in the extreme northwest corner of Nevada in Washoe and Humboldt Counties, protects more than 202,345 hectares (500,000 acres) of high desert habitat for large herds of pronghorn antelope, flocks of Greater Sage-Grouse, and a rich assortment of other wildlife. The landscape is vast, rugged, and punctuated with waterfalls, narrow gorges, and lush springs among rolling hills and expansive tablelands of sagebrush and mountain-mahogany. http://www.fws.gov/sheldonhartmtn/Sheldon

The *Stillwater National Wildlife Refuge Complex* includes three northern Nevada refuges – Stillwater and Fallon near the town of Fallon, and Anaho Island in Pyramid Lake. http://www.fws.gov/stillwater/

- *Stillwater NWR* is located in the Lahontan Valley, near the community of Fallon, 100 km (60 miles) east of Reno. The Stillwater wetlands are well-known to birders, as this area has been designated a site of international importance by the Western Hemispheric Shorebird Reserve Network because of the hundreds of thousands of shorebirds passing through during migration. Also listed as a 'Globally Important Bird Area' by the American Bird Conservancy, more than 280 species have been sighted in the area. These tremendously rich and diverse wetlands attract more than 250,000 waterfowl each year, as well as over 20,000 other water birds.

- *Fallon NWR*, located in the Lahontan Valley near the town of Fernley, includes gently rolling to flat desert shrublands consisting of greasewood and saltbush. A system of both active and stable dunes also accentuates the topography in this area. The terminus of a branch of the Carson River occurs on the Fallon NWR, providing habitat for both waterfowl and upland game.

- *Anaho Island NWR* is located near the eastern shoreline of Pyramid Lake. The refuge is a sanctuary for colonial nesting birds, primarily American White Pelicans. Anaho Island is isolated within the Pyramid Lake Paiute Indian Reservation, but is managed by the Fish and Wildlife Service as part of the National Wildlife Refuge System under an agreement with the Pyramid Lake Paiute Tribe.

- ***Partners for Fish and Wildlife Program***

The goal of the Partners for Fish and Wildlife Program is to work with private and Tribal landowners who want to voluntarily improve fish, wildlife, and plant habitat on their lands. The program provides cost-share funding and technical expertise to these landowners. The Nevada Partners for Fish and Wildlife Program is coordinate by Service staff biologists in Reno, Elko, and Las Vegas. The program's focus is on improvement of wetland, riparian, sagebrush/grasslands, desert scrub, wet-meadow, and aquatic habitats to benefit migratory birds, and threatened, endangered and other sensitive or declining species.
http://www.fws.gov/nevada/partners/index.html

The ***Office of Migratory Bird Management of the Fish and Wildlife Service*** is dedicated to conserving migratory bird populations and their habitats in sufficient quantities to prevent them from being considered as threatened or endangered; and to ensure the citizens of the United States continued opportunities to enjoy both consumptive and nonconsumptive uses of migratory birds and their habitats.

Bureau of Land Management (BLM)

Approximately 68 percent of the State of Nevada's land base is under multiple use management by BLM. Resource Management Plans provide management guidance for individual BLM districts, including standards and guidelines for maintaining or improving the various resources that occur within that district. BLM programs must consider wildlife, habitats, and sensitive species issues in their decision-making processes. In addition, the individual districts have responsibility for proactively managing critical wildlife resources such as endangered species, and riparian and wetland habitats, and regularly participate in various partner-based efforts such as the Governor's sage grouse team, species recovery implementation teams, and game projects.

The BLM also manages the public landscape under regionally focused efforts such as the Great Basin Restoration Initiative, or on a more local scale, under guidance provided in area plans. For example, there are three National Conservation Areas and several designated wilderness areas managed by BLM in Nevada, as well as numerous Wilderness Study Areas that are managed for their natural character. In collaboration with the University of Nevada, BLM initiated a Great Basin Cooperative Ecosystem Studies Unit with a mission of providing research, technical assistance and education to address resource issues and assist inter-disciplinary problem-solving in an ecosystem context. http://www.blm.gov/nv/st/en.html

National Park Service (NPS)

NPS lands in Nevada include Great Basin National Park in White Pine County, a portion of Lake Mead National Recreation Area in Clark County, and a small corner of Death Valley National Park in Nye and Esmeralda counties. The mission of the NPS is to preserve, protect, and manage biological resources and related ecosystem processes in the National Park System. Accordingly, the individual parks take a proactive ecosystem-based approach to management, and maintain active programs devoted to management of park resources for the protection of wildlife, endangered species, and habitats. http://www.nps.gov/nv/

The U.S. Forest Service (USFS)

The USFS administers approximately eight percent of the land base in the state, primarily as the Humboldt-Toiyabe National Forest, the largest National Forest in the lower 48 states. A small portion of the Forest Service lands in Nevada are managed by the Inyo National Forest and the Lake Tahoe Basin Management Unit. The Humboldt-Toiyabe is comprised of 10 Ranger Districts, each geographically separated by a vast landscape of public lands. The Forest Service manages their landscape under the direction of Forest Plans that provide standards and guidelines for managing natural resources. The Humboldt-Toiyabe Forest Plan is currently being revised. http://www.fs.usda.gov/htnf/

Department of Defense (DOD)

In Nevada, DOD manages more than 2,023,428 hectares (5 million acres) of lands, including the Nellis Air Force Range, Fallon Naval Air Station, and Hawthorne Army Munitions Depot. DOD lands are typically closed to public and multiple uses. As a result, many portions of these installations are relatively unfragmented and undisturbed. In 1990, Congress passed legislation establishing the Legacy Resource Management Program to provide financial assistance to DOD efforts to preserve natural and cultural heritage. The program assists DOD in protecting and enhancing resources while also supporting military readiness. The DOD has partnered with The Nature Conservancy partners and other partners on the Legacy Program to develop conservation area plans for both the Hawthorne installation and Fallon NAS.

Department of Energy (DOE)

The DOE's only significant land base in the State is the Nevada Test Site (NTS) located in Nye County, in southcentral Nevada. The NTS is one of the largest restricted access areas in the United States. The remote site is surrounded by thousands of additional acres of land withdrawn from the public domain by Nellis Air Force Range and the Desert National Wildlife Range. All together, these lands comprise an unpopulated land area of approximately 14,165 square kilometers (5,470 square miles). Public access to the Nevada Test Site is strictly controlled; therefore the wildlife habitats are generally in good condition. Habitat types include various desert scrub and lower montane woodland systems. http://www.nv.doe.gov/default.htm

U.S. Bureau of Reclamation (USBoR)

USBOR maintains active environmental programs at both ends of the State. The Lahontan Basin Area Office provides management and oversight for Reclamation activities and interests in the three river basins which make up the Lahontan Basin Area. The area managed includes the Carson, Truckee, and Humboldt River basins. The major programs of the Lahontan Basin Area Office are primarily related to water rights on the Truckee River and the operation of the Newlands Project. The water right issues are complicated by the endangered cui-ui and the threatened Lahontan cutthroat trout in Pyramid Lake, the trust responsibility of the Secretary to both the Pyramid Lake Paiute Tribe and the Fallon Paiute-Shoshone Indian Tribe, and their obligation to provide water for the Lahontan Valley wetlands. http://www.usbr.gov/mp/lbao

The Lower Colorado Region office of USBR manages the Colorado River to meet water and power delivery obligations, enhance outdoor recreation opportunities, and provide flood control. Associated with these activities, the USBR has programs focused on protection of endangered species and enhancement of native habitats for Colorado River fishes and riparian birds. http://www.usbr.gov/lc/

Natural Resources Conservation Service (NRCS)

The NRCS provides conservation assistance to agricultural producers, Native American tribes, units of state and local government, and other Federal agencies in the planning, development and implementation of conservation systems. The purposes of these conservation systems are to reduce erosion, improve soil and water quality, improve and conserve wetlands, enhance fish and wildlife habitat, improve air quality, improve pasture and range condition, reduce upstream flooding and improve woodlands. NRCS offers a variety of incentive-based conservation programs aimed at species and habitat conservation including: the Wetlands Reserve Program, Grassland Reserve Program, Environmental Quality Incentive Program, and Wildlife Habitat Incentive Program. NRCS continually strives to build, develop, facilitate, and promote cooperative conservation partnerships. NRCS and partnering agencies administer programs to assist farmers, ranchers, and other landowners in conserving natural resources. Many of these programs identify at-risk species and the conservation of critical habitat as a priority. These programs provide technical, as well as financial, assistance in order to achieve the implementation of appropriate conservation systems. The NV WAP will be used to help direct program funds to assist in the conservation of priority species and habitat types. http://www.nv.nrcs.usda.gov.

- *Wetlands Reserve Program (WRP)* offers landowners assistance to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS' goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program.

- *Wildlife Habitat Incentives Program (WHIP)* provides assistance for developing and improving wildlife habitat, primarily on private land. Under this program, NRCS provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat.

- *Environmental Quality Incentives Program (EQIP)* provides a conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

U.S. Environmental Protection Agency (EPA)

The EPA develops and enforces regulations that implement environmental laws passed by Congress, including the Clean Water Act. Research grants are available through this agency to answer a broad range of questions associated with environmental quality. Nevada is situated in EPA Region 9 which maintains its regional office in San Francisco, California. Current areas of focus in Nevada include Lake Tahoe and the Carson River, SW ReGAP, and the Declining Amphibian Population Task Force (especially declining amphibians in southern Nevada). http://www.epa.gov/aboutepa/region9.html

USDA APHIS Wildlife Services

The Wildlife Services division of the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) provides assistance in resolving conflicts between wildlife and people. Wildlife Services personnel address issues of wildlife depredations on agricultural crops, livestock, and property as well as respond to wildlife-related issues of public safety. In Nevada, offices are maintained in Reno and Las Vegas and field agents are stationed in several rural areas around the state.
http:/www.aphis.usda.gov/wildlife_damage/state_office/nevada_info.shtml

Desert Terminal Lakes

Provides $200 million to the Department of Interior to find ways to provide water to at-risk natural desert terminal lakes, such as Pyramid Lake, Summit Lake, and Walker Lake. Currently, the Desert Terminal Lakes program is managed by the Bureau of Reclamation office.

U.S. Geological Survey – Biological Research Division (BRD)

The mission of BRD is to provide science expertise to support sound management and conservation of the Nation's biological resources. In Nevada, BRD research is focused in on population biology and species-habitat relationships of desert fishes; ecology and physiology of desert tortoise and other Mojave Desert reptiles; and fire ecology of Mojave Desert ecological systems. http://www.werc.usgs.gov/

U.S. Army Corps of Engineers (COE)

Provides engineering services for designing, building and operating water resources and other civil works projects. In Nevada, the COE is a partner in various habitat management efforts, including restoration of the Truckee River through Reno and Sparks, and mitigation programs for aquatic species in water streams, rivers, and lakes throughout the state. http://www.spk.usace.army.mil/

State Agencies

Nevada Natural Heritage Program (NNHP)

The mission of the NNHP is to help coordinate the resource needs of Nevada's diverse biological heritage with human activities. This is primarily achieved through the maintenance of an inventory and current databases on the locations, biology, and conservation status of all threatened, endangered, and sensitive species and biological communities in the state. Heritage also participates in and contributes to various species conservation strategies, mostly notably, the Nevada Bat Conservation Plan, amphibian conservation strategies, and aquatic species recovery implementation teams.

The NNHP uses the best available biological data to evaluate conservation priorities for over 700 kinds of native animals, plants, vegetation types, and their habitats–those at greatest risk of extinction or serious decline–and supplies information and technical services to meet diverse conservation, planning, development, land management, and research needs. NNHP provides the citizens of Nevada with a cost-effective early warning system, designed to minimize future resource conflicts, and to help prevent species from becoming threatened or endangered by encouraging less costly, less burdensome, and more proactive conservation measures. The

NNHP is a contributing member of NatureServe, a network connecting science with conservation, consisting of natural heritage programs and conservation data centers found across the United States, Canada, and Latin America. It is also part of the National Biological Information Infrastructure.

The NNHP is the lead state resource agency for development of the Nevada Wetland Information System and Geographic Information System and the preparation of the Nevada Wetland Priority Conservation Plan. The purpose of these projects is to create, maintain and update a biological, technical, and institutional information base and make it available for preparation of a comprehensive state conservation strategy; as a supporting element for various agency and collaborative plans involving wetlands, aquatic habitats, watershed, wildlife, sensitive species, outdoor recreation and other natural resources; and, for projects to conserve, restore, or develop wetland resources. http://heritage.nv.gov/

Nevada Division of Forestry (NDF)

Manages forestry, nursery, endangered plant species, and watershed resource activities on certain public and private lands; and provides fire protection for natural resources through fire suppression and prevention, post-fire rehabilitation, and prescribed burning. NDF resource programs that provide assistance to private landowners for proper management of forests and piñon-juniper woodlands also can result in conservation and enhancement of wildlife habitat on privately-owned land. http://forestry.nv.gov/

- *Forest Stewardship Program and Stewardship Incentives Program (SIP)* offer cost shares and grants to assist landowners with implementation of conservation projects such as reforestation, wildlife habitat improvement, and soil and water conservation.

- *Nursery and Seedbank Program* provides native and adapted plant materials, seedlings and seed, for post-burn rehabilitation, riparian restoration, and other conservation projects on federal, state, and private lands.

NDF, in conjunction with the Department of Corrections, operates the Conservation Camp Program that provides trained and equipped inmate crews to fight fires and assist on resource conservation projects. The program provides a statewide labor force for vegetation management and other worthwhile conservation projects.

Nevada Division of State Parks (NDSP)

Manages 24 State Parks across the state with three primary purposes – historical preservation, resource protection, and outdoor recreation. Several State Park properties contain key habitats for some of Nevada's Species of Conservation Priority, including California Spotted Owl, Northern Goshawk, Yellow-billed Cuckoo, and Yuma Clapper Rail. Each State Park operates under a Master Plan that identifies resource values such as important wildlife species and habitats. Park operations are designed to meet stewardship responsibility for the management of these natural resources with minimum impacts. Several properties have "backcountry" designations with specific backcountry management goals and objectives that focus on resource maintenance and protection. http://parks.nv.gov/

Nevada Division of Environmental Protection (NDEP)

As the lead agency for the protection of water quality and achievement of standards, NDEP implements programs to address nonpoint source pollution. The *Division's Bureau of Water Quality Planning* annually awards federal Clean Water Act Section 319 funds through the Nonpoint Source Program for projects that reduce, eliminate, or prevent Non-point source pollution. With an emphasis on the watershed approach, many types of water quality improvement projects also enhance habitat conditions for wildlife. Funded projects include seeding eroding upland slopes with native and adapted grasses, forbs, and shrubs; stabilizing eroding channel banks; rehabilitating riparian areas; and constructing fences and livestock watering systems to control livestock access to riparian areas. http://ndep.nv.gov/

The ***Department of Environmental Protection's Bureau of Mining Regulation and Reclamation*** regulates mining activities in Nevada to ensure that Nevada's waters are not degraded by mining operations and that the lands disturbed by mining operations are reclaimed to ensure a productive post-mining land use. The Reclamation Branch regulates exploration and mining operations in Nevada on private and public lands. An operator must obtain a reclamation permit prior to construction of any exploration, mining, or milling activity that will disturb over 2 hectares (5 acres) or remove in excess of 37,085 metric tons (36,500 tons) of earth materials. In coordination with NDOW, the Bureau of Mining Regulation and Reclamation can help ensure that permitted mining related activities minimize impacts on wildlife and their habitats; including the conservation of subterranean habitats for bat roosting, reproduction, and hibernation. http://ndep.nv.gov/bmrr/index.htm

Nevada Division of Minerals (NDOM)

Conducts a program to identify inactive mines in the State, rank their degree of hazard and carry out activities to secure the sites, through owners or division staff. Through a cooperative agreement between the division and the BLM, abandoned mines scheduled for closure can be assessed for their values as wildlife habitats and measures may be taken to retain their habitat values. http://minerals.state.nv.us/

Nevada Division of State Lands (NDSL)

Offers planning assistance to local governments in preparation of master plans and public land policy plans. The NDSL also conducts community planning training workshops for local government officials and residents. These are opportunities to coordinate planning activities that influence wildlife habitat. The Division of State Lands also represents state and local interests, including those related to wildlife and habitat management, on federal land management projects.

Two other projects in which the NDSL is involved present opportunities to increase public awareness of the importance of wildlife conservation efforts, and perhaps could lead to added support for local wildlife planning. The NDSL is assisting the Governor's office with implementation of the Western Governors Association (WGA) Enlibra Program. Case studies of local collaborative planning projects, such as were recently convened for sage grouse, are being developed for a western U.S. Enlibra Summit. Lessons learned from the case studies and at the Summit may lead to a WGA effort to obtain resources to assist local collaborative planning groups. The Governor's office and the NDSL are also updating Nevada's Public Land Policy Plan. Related action items are being identified that might benefit wildlife in conservation need along with other public land resources and nearby communities. http://lands.nv.gov/

Nevada Department of Agriculture (NDOA)

NDOA encourages the advancement and protection of agriculture and related industries for the benefit of Nevada citizens. NDOA works in a voluntary manner with interested landowners to address issues involving production agriculture. Because a large portion of the agricultural production in Nevada is dependent on access to and use of natural resources located on public lands, the department is often involved in the resource issues associated with these activities. The NDOA Natural Resource Program is involved in all aspects of natural resource management or environmental regulation that affects, or is affected by, agriculture in Nevada. Due to staffing and budgetary limitations, this program usually focuses on broad programmatic issues, as opposed to specific issues or situations affecting individuals.

NDOA has primary responsibility for the enforcement of noxious weed laws and for control of noxious weeds for the protection of agricultural and natural resources. The agency is also responsible for Nevada's Coordinated Invasive Weed Strategy, which works from a platform of collaborative, linked efforts to prevent, control, and manage invasive weed species. NDOA, in conjunction with the University of Nevada's Cooperative Extension, the USDA Agricultural Research Service, and the NRCS, helps to build awareness of economically acceptable farming and ranching practices that aid in the conservation of wildlife and their habitats.

Other program activities include maintenance of the Department's public land grazing trend data base and economic analysis; administration of the Nevada Agricultural Mediation Service – a state program funded by a USDA grant. NDOA administers Section 8 Review process (Pesticide Registration Improvement Act)–a program designed to provide conflict resolution among BLM, USFS and permittees at the allotment level. NDOA works with the Board of Agriculture and other state agencies to develop state policies and comments on natural resource and public land issues and participates in the Executive Coordinated Resource Management (CRM) process and other similar processes in the state. The agency provides input into various land and resource planning processes throughout the state, and organizes and supports the Department's Environmental Action Committee. http://agri.state.nv.us/

Tribal Lands and Governments

Nevada includes 19 federally recognized Native American tribes comprised of 28 separate tribes, bands, and community councils. The estimated land area that they collectively own and manage is approximately 485,625 hectares (1.2 million acres). Tribal lands include colonies, reservations, allotments, ranches, tribal fee land, federal land, government-owned land, and trust lease lands. Wildlife resources on these lands are typically managed through established wildlife and fisheries management programs, sometimes in partnership with Federal and State resource agencies. For example, the Pyramid Lake Tribe actively manages their cui-ui and Lahontan cutthroat trout resources and maintains working partnerships with the U.S. Fish and Wildlife Service and Nevada Department of Wildlife.

A few other ongoing and active tribal wildlife efforts include the Duckwater Tribe's cooperative relationship with the USFWS to manage for Railroad Valley springfish, and the partnership between the Moapa Band of Paiutes and various others to manage for riparian and aquatic wildlife on the upper Muddy River. Recently, the Summit Lake Paiute Tribe received funding to establish a Greater Sage-Grouse conservation program and the Walker River Paiute Tribe has established a fisheries program focusing on Lahontan cutthroat trout.

The Nevada Indian Commission is a state agency created to study matters affecting the social and economic welfare and well-being of American Indians residing in Nevada. Commission activities are aimed at developing and improving cooperation and communications among the Tribes, State, local governments, and related public agencies. The Commission serves as liaison between the State and the 19 federally recognized tribes. The Commission has assisted state agencies and Tribes with issues affecting Nevada's American Indian constituency and serves as a forum in which Indian needs and issues are considered. The Commission is a conduit by which concerns involving Native American Indians or Tribal interests are channeled through the appropriate network and serves as the point of access for Tribes to learn about state government programs and policies.

Another entity that focuses on Nevada's tribes and tribal members is the Inter-Tribal Council of Nevada. The main intent of ITCN is to serve as a large political body for the small Nevada Tribes. From that point in time, ITCN has played a major role in promoting Health, Educational, Social, Economic, and Job Opportunity Programs. ITCN now manages Federal and State funded programs aimed at improving the well-being of community members throughout the State of Nevada. http://www.itcn.org/ITCN%20Home.html

Nevada's Local Government Agencies and Programs

Nevada Association of Counties (NACO)

A nonpartisan, nonprofit corporation, owned, organized, and operated by Nevada's county governments that has a membership composed of Nevada's county governments and represents all 17 Nevada counties. The mission of NACO is to "encourage county government to adopt and maintain a spirit of local, regional, state, and national cooperation which will result in public policy that optimizes the management of county personnel, financial, and natural resources; to provide courteous and effective services that will earn and maintain the public trust in county government." http://nvnaco.org/

Counties

Nevada's counties are integral partners in any wildlife management plans and programs. County roles will vary widely, depending on individual project goals, but may include the participation of parks and recreation departments, animal control divisions, or urban redevelopment committees. Many counties were closely involved with the local sage grouse working groups in developing the local area plans that were incorporated into the Governor's sage grouse effort.

Several counties have incorporated wildlife standards and guidelines directly into their planning efforts. For example, Churchill County developed wildlife standards for their Quality of Life plan, while Clark County convened the Environmentally Sensitive Lands Committee to identify sideboards for future development. Lincoln County has developed a county-wide multi-species habitat conservation plan while Lyon County has developed a middle Carson River centric habitat conservation plan. A variety of other local entities guide wildlife management activities in Nevada.

Conservation Districts

Conservation Districts coordinate assistance from public and private, local, state and federal entities, in an effort to develop locally driven solutions to natural resource concerns. In Nevada, there are currently 28 conservation districts. Similarly, Town Advisory Boards can play a role in monitoring and advising the effects of agency programs on their local communities. http://www.nacdnet.org/about/districts/directory/nv.phtml

Water Management Entities

Water Authorities, Water Districts, and Irrigation Districts may also participate in wildlife management activities. The **Southern Nevada Water Authority (SNWA)** mission is to manage the region's water resources and develop solutions that will ensure adequate future water supplies for the Las Vegas Valley. The SNWA develops and manages a "flexible portfolio of diverse water resources." This portfolio includes a variety of Colorado River and in-state resources, including both surface water and groundwater rights and groundwater applications. As a matter of course, the SNWA evaluates the potential impacts of its actions on the environment and strives to balance resource needs with the preservation of wildlife habitat. Accordingly, their environmental research division coordinates with agencies and other entities to use science to inform their decision making process.

The **Truckee Meadows Water Authority (TMWA)** was formed in 2000 as a collaboration among the Cities of Reno and Sparks, and Washoe County, as a means of efficiently managing water resources. Other bodies that may play a role in wildlife management include local irrigation or water districts.

Tahoe Regional Planning Agency (TRPA) is a bi-state agency charged with protecting Lake Tahoe through maintenance of a clean, healthy and sustainable lake environment. The TRPA sets goals and standards for Environmental Thresholds carrying capacities for fish and wildlife habitat (and other resources), and enforces implementing ordinances to achieve and maintain such capacities while providing opportunities for orderly growth and development consistent with such capacities. The Lake Tahoe Environmental Improvement Program (EIP) is a multi-partner cooperative effort to define restoration needs for achieving the thresholds.

Conservation Organizations

The Nature Conservancy (TNC)

The Mission of The Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. TNC has developed a strategic, science-based planning process, called Conservation by Design, which helps identify the highest-priority places–landscapes that, if conserved, promise to ensure biodiversity over the long term. Taken together, these landscapes form a vision of conservation success and a roadmap for getting there–the Conservation Blueprint. TNC has five priority conservation initiatives to address the principal threats to conservation at the sites where they work, focusing on fire, climate change, freshwater, marine, and invasive species. TNC works to preserve lands and waters for future generations by working with communities, businesses, governments, partner organizations, indigenous people and communities.

The Nature Conservancy's Nevada program is focused on protecting a suite of high priority conservation areas through stewardship and partnership. Current programs are addressing conservation needs on the Truckee, Carson, and Amargosa, in eastern Nevada's sagebrush and piñon-juniper habitats, and in high biodiversity areas throughout the state with a current emphasis on those dependent upon reliable water supplies.
http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/nevada/index.htm

American Land Conservancy (ALC)

A national organization that protects land for the benefit of people and wildlife. ALC works in partnership with communities, private landowners, local land trusts, and public land agencies to find effective conservation solutions for threatened natural resources. ALC uses techniques such as land acquisition, conservation easements, and the acquisition of water rights, grazing leases or other interests in land. ALC's projects in Nevada lie primarily in the vicinity of the Carson Range. http://www.alcnet.org/

Nevada Land Conservancy

A Nevada-based land trust working with landowners and communities to protect and preserve open space for an enhanced quality of life. With the help of members, volunteers, land owners, businesses and government agencies, the Nevada Land Conservancy protects special places through acquisition, easement, open space planning, outreach and environmental restoration. http://www.nvlc.org/

Trust for Public Land (TPL)

A national land conservation organization that conserves land for people to enjoy as parks, community gardens, historic sites, rural lands, and other natural places, ensuring livable communities for generations to come. TPL's conservation work focuses on protection strategies for parklands, working landscapes, natural areas, and sites of cultural, historic, and aesthetic significance. TPL also offers conservation planning services for agencies and communities. TPL has active projects across the state. http://www.tpl.org/

The Conservation Fund

Working through partnerships to preserve wildlife habitat, working landscapes and community open-spaces. Since 1996 the Fund has worked with local ranchers, the BLM, U.S. Fish and Wildlife Service, and Clark County to purchase willing sellers' grazing allotments on public lands and open space in Las Vegas Valley and Washoe Valley. http://www.conservationfund.org/

Desert Fishes Council (DFC)

Focused on preserving the biological integrity of desert aquatic ecosystems and their associated life forms, holds symposia to report related research and management endeavors, and effects rapid dissemination of information concerning activities of the Council and its members. Although DFC's main focus is desert fishes, other aquatic species associated with desert ecosystems (e.g. amphibians) are also included under its umbrella.

DFC was formed in response to impacts to habitats of the endemic fishes of Ash Meadows and nearby Death Valley from groundwater pumping for agricultural development. Concerned biologists and management agency officials convened a symposium to address the threats and protection and preservation of this unique fauna, and it was at this symposium, in November 1969, that the Desert Fishes Council was born.
http://www.desertfishes.org/

Audubon Society Nevada Important Bird Area Program

Audubon's Important Bird Areas (IBA) Program is statewide program designed to identify areas that provide exceptional habitat for birds at various times in their life history and to seek opportunities to help steward these areas. These IBAs embody interagency cooperation and public participation and contribute not only to a state and regional level understanding of bird habitat requirements, but to a national and global effort to protect birds and their habitat. The Nevada IBA Program is part of a global partnership between National Audubon Society and BirdLife International. http://www.nevadaaudubon.org/iba.html

Lahontan Audubon Society

Serves northern Nevada, representing 1,000 conservation-minded members, to help restore, preserve, and improve habitat for birds and other wildlife and to provide education about birds and their habitats in Nevada and adjacent areas of California. Members help protect and preserve the environment by participating in activities such as site clean-ups and improvements. They volunteer their time helping to educate the public about birds and bird habitat through birding classes, field trips, and school presentations, so the public may gain an appreciation for the environment and become good stewards of the land. http://www.nevadaaudubon.org/

Red Rock Audubon Society

Serves southern Nevada and is the Las Vegas chapter of the National Audubon Society. Their mission is to protect, restore and improve the natural ecosystems, focusing on birds and other wildlife, and to educate the public about our unique Nevada environment. Red Rock Audubon sponsors various meetings, educational programs, field trips, and volunteer events to facilitate bird conservation in southern Nevada.
http://www.redrockaudubon.org/

Bristlecone Audubon Society

The newest chapter within Nevada is centered out of Elko and serves the northeastern corner of the state. Being a newcomer to the Audubon family, this chapter has been focused on providing field trips, Christmas Bird Counts, and volunteer events. http://bristleconeaudubon.webnode.com/

Sierra Club

As America's oldest, largest, and most influential grassroots environmental organization, the Sierra Club's mission includes exploring, enjoying and protecting the wild places of the earth; practicing and promoting the responsible use of the earth's ecosystems and resources; educating and enlisting humanity to protect and restore the quality of the natural and human environment; and using all lawful means to carry out these objectives. The Sierra Club has two chapters in Nevada. http://nevada.sierraclub.org/

Truckee River Yacht Club

Works for the betterment of the Truckee River from its source in Lake Tahoe to its terminus at Pyramid Lake. The Truckee River Yacht Club works on a variety of issues including water quality and maintaining minimum flows, improving dams to allow fish movements through the watershed, improving access for recreational users, minimizing human impacts in the river's floodplain, and volunteer based river clean-up efforts.
http://www.truckeeriver.org/dev/about.php

Walker Lake Working Group

The task of this group is to prevent the collapse of the Walker Lake ecosystem and improve the health of the lake. The Group works to build public support for a long-term solution to protect the lake without jeopardizing the upstream community. The group has three specific goals: the reestablishment of spawning runs of the Lahontan cutthroat trout; delivery of sufficient water to the lake so that Total Dissolved Solids (salt) levels are low enough to support the Walker Lake ecosystem; and, to acquire and transfer water rights for environmental and recreational purposes. http://www.walkerlake.org/

Declining Amphibian Population Task Force (DAPTF)

Established in 1991 by the Species Survival Commission of the World Conservation Union (IUCN), in response to an emerging pattern of global amphibian declines. Its mission is to determine the nature, extent, and causes of declines of amphibians throughout the world, and to promote means by which declines can be halted or reversed. DAPTF includes approximately 90 Regional Working Groups that focus on collecting data on amphibian declines and their causes. Other issue-based working groups include Disease and Pathology, Monitoring Techniques, Chemical Contaminants, Climatic and Atmospheric Change, and Captive Breeding. The California/Nevada Chapter meets approximately annually, focusing on these issues as they apply to California and Nevada populations. http://www.canvamphibs.com/

Partners in Amphibian and Reptile Conservation (PARC)

An inclusive partnership dedicated to the conservation of the herpetofauna (reptiles and amphibians) and their habitats. Membership includes individuals from state and federal agencies, conservation organizations, museums, pet trade industry, nature centers, zoos, industries, herpetological organizations, research laboratories, forest industries, and environmental consultants. PARC focuses on habitat, endangered and threatened species, and keeping common native species common. http://www.parcplace.org/

Wildlife and Habitat Improvement of Nevada (WHIN)

A sportsman and conservation organization devoted to the maintenance and betterment of Nevada's wildlife populations and their habitat. Many of the members devote countless hours to carry out work projects and to plan and execute the annual banquet, picnic and other social activities. Funds raised by WHIN are used to purchase materials for field projects, for contributions to government agencies such as NDOW for specific purposes, such as wildlife research and habitat improvement; or, to make donations to, or pool resources with, other non-profit organizations for wildlife management projects in Nevada. http://www.whinlv.org/

Nevada Wilderness Coalition

An affiliation of various wilderness advocacy organizations, including Friends of Nevada Wilderness, the Nevada Wilderness Project, The Wilderness Society, Campaign for America's Wilderness, Nevada Outdoor Recreation Association, and Red Rock Audubon Society. Collectively these organizations represent more than 7,000 Nevadans. http://www.wildnevada.org/

Great Basin Land and Water (GBLW)

A non-profit Nevada corporation established to acquire water rights for conservation, in order to benefit the long-term ecological health of the Truckee River and Pyramid Lake. GBLW works with the Pyramid Lake Paiute Tribe and local governments to improve water quality in the Truckee River.
http://www.greatbasinlandandwater.org/

Lahontan Wetlands Coalition

An informal group of representatives from the Sierra Club, Lahontan Audubon Society, Nevada Waterfowl Association, and other interested people and organizations focused on obtaining water for wetlands in the Lahontan Valley, transferring Carson Lake to the State of Nevada, encouraging cooperative management of water between the state of Nevada and federal agencies to sustain wetland dependent birds, and assisting with habitat improvements.

HawkWatch International (HWI)

The mission of this organization is to monitor and protect hawks, eagles, other birds of prey and their environments through research, education, and conservation. HWI and its organizational precursors have been studying the fall raptor migration in the Goshute Mountains of northeastern Nevada since 1980. In addition to gathering important scientific data, the Goshute project provides opportunities for the public to learn about the ecology and conservation needs of raptors through on-site environmental education and interpretation conducted by full-time volunteer educators. http://www.hawkwatch.org/

League to Save Lake Tahoe

This organization has advocated for the protection and restoration of Lake Tahoe since 1957. The League is supported by more than 5,000 individuals and families. The League was instrumental in the creation of the TRPA and the development of a regional plan for the area. The League has developed a history of building public support for conservation of the Tahoe Basin, bringing science into public decision-making, winning litigation when necessary to enforce the law, and building consensus among business and government leaders in support of protecting and restoring Lake Tahoe. http://keeptahoeblue.org/

Nevada Wildlife Federation

Dedicated to sustaining Nevada's natural resources for wildlife through conservation and education. The Federation is one of the oldest and largest conservation organizations in Nevada, founded in 1951 by sportsmen with an interest in wildlife. Today their membership is diversified and is involved not only in wildlife conservation, but related natural resource conservation issues. The Federation has 20 Affiliate member organizations in Nevada with more than 5,000 members. Its programs emphasize youth conservation education, installing stream structures to improve native trout habitat, fencing springs to prevent trampling by livestock and wild horses, developing educational materials for sage grouse, and counting sage grouse on leks each spring. http://nvwf.org/

Friends of Nevada Wilderness

Friends of Nevada Wilderness is dedicated to preserving all qualified Nevada public lands as wilderness, protecting all present and potential wilderness from ongoing threats, educating the public about the values of and need for wilderness, and improving the management and restoration of wild lands.
http://www.nevadawilderness.org/

Sportsman's Groups

Coalition for Nevada's Wildlife

A sportsmen conservationist group that provides a unified voice for sportsmen in the legislature. The Coalition represents all types of sportsmen, including big game, waterfowl, upland game, fishing, trapping, houndsmen, rod and gun clubs and general conservationists. During legislative sessions, the Coalition allows rapid dissemination of information to each Coalition member group pertaining to relevant wildlife issues.

Fraternity of the Desert Bighorn

A non-profit organization dedicated since 1964 to the utilization, conservation, and welfare of the desert bighorn sheep in Nevada. The organization offers support to various government agencies associated with the care and protection of the desert bighorn. In addition, the organization strives to inform the public as to many of the problems involving the desert bighorn sheep and our advancing civilization. http://www.desertbighorn.com/

Mule Deer Foundation (MDF)

Mule Deer Foundation and its corps of volunteers work to ensure the conservation of mule deer and blacktail deer and their habitats. MDF is headquartered in Reno and has over 10,000 members and approximately 65 chapters nationwide. MDF volunteers raise thousands of dollars to help fund habitat and conservation projects throughout the West. MDF's goals center on restoring, improving and protecting mule deer habitat, which results in self-sustaining, healthy, free-ranging, and huntable mule deer populations. MDF supports scientific research and is a co-founder of the Chronic Wasting Disease (CWD) Alliance. MDF also implements conservation education programs. http://www.muledeer.org/

Nevada Bighorns Unlimited (NBU)

Nevada Bighorns Unlimited (NBU) was founded in 1981 by a small group of Nevada sportsmen and conservationists. Since its beginning, NBU has grown into a successful, action-oriented, non-profit organization with a membership base of over 3,500. NBU is an organization concerned with the conservation and management of not only bighorn sheep, but all of Nevada's wildlife. The organization's mission is to promote and enhance increasing populations of wildlife in Nevada, to fund programs for professional management and habitat improvements, and to protect the heritage of sportsmen and hunters. NBU has chapters in Midas, Elko, Fallon, and Reno. http://nevadabighornsunlimited.org/

Nevada Sportsman Coalition (NSC)

Nevada Sportsman Coalition (NSC) is dedicated to promoting the charitable works of conservation organizations to the general public and educating Nevada's population on issues facing sportsmen. Through their efforts, NSC encourages Nevada's youth to enroll in conservation education programs. Nevada sportsmen have contributed millions of dollars and thousands of hours to habitat and wildlife restoration. NSC recognizes that the survival of the sportsmen and their charitable efforts is tied to the public's continued interest in their works.

Nevada Trappers' Association

Nevada Trappers' Association promotes sound and sensible policies and opposes bad policies pertaining to furbearer management. The Association promotes the education of young trappers and the public, the latter regarding the consumptive use of wild animals as a necessary wildlife management tool. The Association also promotes the continuation of an annual fur harvest using the best tools presently available for that purpose. http://www.nvtrappers.org/

Ducks Unlimited (DU)

Ducks Unlimited (DU) conserves, restores, and manages wetlands and associated habitats for North America's waterfowl. Currently there are 26 active chapters in Nevada that raise funds for wildlife habitat projects through the sponsorship of local banquets and other events. DU provides representation to the Nevada Steering Committee of the Intermountain West Joint Venture. http://www.ducks.org/nevada

Nevada Waterfowl Association

Nevada Waterfowl Association's mission is to protect, restore and enhance Nevada's wetlands and the wildlife dependent upon them, especially waterfowl and shorebirds. Nevada Waterfowl Association is a family-oriented conservation organization that was created in 1987 by a group of individuals who were alarmed at the rate of loss of Nevada's unique desert wetlands. The organization works closely with agencies and other organizations, including the USFWS, NDOW, Lahontan Wetlands Coalition, DU, Canvasback Gun Club, Greenhead Hunting Club, and others to preserve Nevada's unique desert wetlands for future generations.
http://www.nevadawaterfowl.org/

Rocky Mountain Elk Foundation (RMEF)

This organization's mission is to ensure the future of elk, other wildlife, and their habitat. The RMEF is committed to conserving, restoring and enhancing natural habitats; promoting the sound management of wild, free-ranging elk; fostering cooperation among federal, state and private organizations and individuals in wildlife management and habitat conservation; educating members and the public about habitat conservation, the value of hunting, hunting ethics and wildlife management. The RMEF meets its mission by funding habitat enhancement projects such as prescribed burns and water developments; wildlife management projects such as elk transplants and cooperative initiatives among elk and livestock interests; research on elk and their habitat to provide wildlife managers with information needed to manage elk; conservation education programs to increase the awareness of the importance of wildlife and their habitat with people of all ages; land conservation projects such as acquisitions and conservation easements; and hunting heritage projects to promote ethical hunting and ensure future hunting opportunities. http://www.rmef.org/Conservation/WhereWeWork/Nevada/

Safari Club International Foundation

Safari Club International Foundation is committed to providing value to members by shaping policies and legislation that protect the freedom to hunt locally, nationally and internationally; keeping members informed regarding issues that impact hunting while educating and entertaining members with engaging articles about the rich heritage of hunting in all forms of media; providing a community for hunters worldwide where camaraderie is enjoyed and expert information is exchanged, and where members are able to participate in a market for quality hunting goods and services; promoting a positive image of hunters and portraying them as responsible citizens who fund wildlife conservation, education and other programs which benefit the community. http://www.safariclubfoundation.org/

Trout Unlimited (TU)

Trout Unlimited (TU) is dedicated to conserving, protecting, and restoring North America's trout and salmon fisheries and their watersheds. TU accomplishes this mission on local, state and national levels with an extensive and dedicated volunteer network. TU's national and regional offices employ professionals who testify before Congress, publish a quarterly magazine, intervene in federal legal proceedings, and work with the organization's 125,000 volunteers in 500 chapters nationwide to keep them active and involved in conservation issues. TU has four chapters in Nevada. http://www.tu.org/

Truckee River Fly Fishers

A conservation and fly fishing club headquartered in Reno and are dedicated to improving and promoting the sport of fly fishing in Nevada by promoting and encouraging the conservation of game fish, especially wild trout, through the betterment of the streams and lakes in Nevada and the Eastern Sierra. They also encourage and assist youth to become fly fishermen and sportsmen. The group developed the Trout in the Classroom program now administered by NDOW in over 100 schools in Nevada. The group conducts river cleanups on the Truckee River and wraps trees to protect them from beaver damage and has also sponsored interpretive displays at the Verdi Nature Center.

Other Key Partners

Eastern Nevada Landscape Coalition (ENLC)

The Eastern Nevada Landscape Coalition (ENLC) is a community-based partnership of about 50 non-governmental partners including agricultural, conservation, cultural, environmental, private enterprise, and other interests. The mission of the ENLC is to restore the dynamic and diverse landscapes of the Great Basin for present and future generations through collaborative efforts. The Coalition's function is to assist in implementing the Eastern Nevada Landscape Restoration Project, a strategy for implementing the Great Basin Restoration Initiative. The ENLC's function is to build partnerships, conduct fundraising, establish goals and objectives, determine the process, and provide science and technical assistance in landscape restoration. http://www.envlc.org/

Intermountain West Joint Venture

The mission of the Intermountain West Joint Venture (IWJV) is to facilitate the long-term conservation of key avian habitat including planning, funding, and developing habitat projects that benefit all biological components of Intermountain ecosystems. The IWJV achieves the mission by developing partnerships with private and public landowners who support habitat conservation, promoting the restoration and maintenance of all bird populations; and fostering the protection, restoration, and enhancement of wetlands, riparian habitats, and the widely diverse uplands characteristic of the region. Each state in the IWJV area has developed a Coordinated State Bird Plan to advance the mission of the IWJV. http://www.iwjv.org

Great Basin Bird Observatory (GBBO)

Formed in 1997, this non-profit organization is dedicated to the conservation and understanding of bird populations in the Great Basin and northern Mojave Desert. GBBO considers its role to be a catalyst for bringing together partners in bird monitoring, inventory, and bird habitat conservation planning, as well as for helping advance the skills of volunteers in bird conservation and knowledge of the interested public about Nevada's birds. GBBO emphasizes partnerships, applied research, building a volunteer community, and public education. Current projects include the Nevada Bird Count and the Aquatic Bird Count, statewide efforts to monitor and track trends in bird populations. http://www.gbbo.org

Nevada Mining Association

The Nevada Mining Association promotes modern mining conducted with environmental sensitivity and careful regard to the environment, assisting Nevada's mining industry in assigning high priority operating in an environmentally responsible manner, to protect wildlife, reclaim mined land, and employ new technologies to make operations environmentally safer. http://www.nevadamining.org

Universities

University of Nevada, Reno (UNR), and University of Nevada, Las Vegas (UNLV) maintain active teaching and research programs focused on wildlife ecology and conservation biology.

Faculty and students in UNR's Department of Natural Resources and Environmental Sciences are studying mammal behavior, habitat use by hawks, waterfowl, and shorebirds, grazing and riparian ecosystem function, forest processes, fire ecology, and nutrient cycling.

The University of Nevada Cooperative Extension Program is also housed at UNR. Its Natural Resources and other programs address a variety of topics related to management of Nevada's wildlife, including riparian habitat, sage grouse management, and invasive weeds. http://www.unce.unr.edu

UNLV's Department of Biological Sciences maintains an active research program, focused in part on ecology, biogeography, systematics, physiology, and genetics. UNLV scientists have conducted a variety of studies on local wildlife, including southern Nevada bats, reptiles, amphibians, and mammals.

Desert Research Institute

The Desert Research Institute (DRI) is the environmental research arm of the Nevada System of Higher Education. DRI conducts cutting-edge applied research in air, land and life, environment, renewable energy, and water quality across Nevada, the United States and on every continent.

Partnership-based Plans and Programs

Conservation programs, plans, agreements, and strategies typically involve a partnership among various public and private partners. These documents generally outline specific conservation measures to identify and reduce or eliminate threats to species, enhance their habitat, and maintain properly functioning ecosystems. Early conservation efforts preserve management options, minimize the cost of recovery, and reduce the potential for restrictive land use policies in the future. Effective conservation may reverse a species' decline, ultimately eliminating the need for protection under the Endangered Species Act. There are a number of existing multi-partner conservation programs, plans, agreements, and strategies in place in Nevada.

Great Basin Environmental Program

A multi-state partnership to improve land health and ecosystem productivity with a proposal to provide new funding, establish partnerships and integrate efforts with federal agencies, state agencies, tribes, NGOs and the private sector to address critical environmental issues. http://greatbasinenvironmentalprogram.org/

Great Basin Cooperative Ecosystem Studies Unit

Provides research, technical assistance and education to federal land management, environmental and research agencies and their potential partners by developing a program of research, technical assistance and education that involves the biological, physical, social, and cultural sciences needed to address resources issues and interdisciplinary problem-solving at multiple scales and in an ecosystem context at the local, regional, and national level. http://www.ag.unr.edu/gbcesu/

Great Basin Landscape Conservation Cooperative

An applied science and management partnerships between Interior Department bureaus and others involved in natural resource management and conservation, designed to better integrate science and management to address climate change and related issues. http://www.blm.gov/wo/st/en/prog/more/Great_Basin_LCC.html

Great Basin Information Project

Provides consolidated and efficient access to information about the Great Basin and the Columbia Plateau Regions. http://greatbasin.nbii.gov

Great Basin Research and Management Partnership

Promotes comprehensive and complementary research and management collaborations to sustain ecosystems, resources and communities across the Great Basin by providing a mechanism for assembling the diverse research and management groups working in the Great Basin to: 1) obtain consensus in identifying and prioritizing regional issues; 2) expand and help focus existing collaborative efforts; and 3) facilitate new teams to address emerging issues. It also provides critical information sharing capacity for both existing collaborations and new teams. http://greatbasin.wr.usgs.gov/gbrmp/index.html

Great Basin Restoration Initiative

Seeks to provide technical assistance and guidance, obtain funding, and keep the issue of the failing Great Basin ecosystems in the public's vision. http://www.blm.gov/id/st/en/prog/gbri.html

Sage Grouse Conservation Plan for Nevada and Portions of Eastern California (Governor's Sage Grouse Conservation Team and local Sage Grouse working groups).

In 2000, Governor Guinn appointed a team of approximately 25 people from diverse backgrounds and interests to his Sage Grouse Conservation Team. The mission of the team, as defined by Governor Guinn, is "To conserve and protect Nevada's sage grouse and their habitat." To address both regional and statewide conservation concerns, the sage grouse conservation planning effort was broken down into seven different planning teams that included state and federal agency personnel, non-government partners and private stakeholders representing a wide variety of interests. Each team drafted a plan identifying local risks to sage grouse populations and identified actions to mitigate these risks. The Governor's Sage Grouse Conservation Team incorporated the local plans and completed the Sage Grouse Conservation Plan for Nevada and Portions of Eastern California in 2004. With the submittal of the state plan to the USFWS, the State provided valuable information regarding the status and conservation needs of the Greater Sage-Grouse in Nevada.

Nevada Wetland Priority Conservation Plan (NvWP)

This plan was prepared by the Nevada Natural Heritage Program, in association with the Nevada Division of State Parks and NDOW. It is a required element of the Nevada Statewide Comprehensive Outdoor Recreation Plan (SCORP), which was updated by the NDSP in 2003. Section 303 of the Emergency Wetlands Resources Act of 1986 (EWRA) directs states to prepare or update a wetland conservation plan as part of its SCORP every five years to maintain eligibility to receive federal Land and Water Conservation Fund (L&WCF) grants. In recent years, the NDSP received over $1 million annually from the L&WCF. The NDSP applies the funds to acquire or develop land, water, or structures for outdoor recreation, including natural and cultural resources. Half of the state's L&WCF allocation is shared with counties and municipalities for local projects.

The EWRA specifies the NvWP must 1) be consistent with the National Wetlands Priority Conservation Plan, prepared by the USFWS; 2) provide evidence of consultation with NDOW, the state agency responsible for fish and wildlife resources; and, 3) identify the state's wetland conservation priorities based on a comparative evaluation of losses and gains, threats, and functions and values, and the alternative strategies for conservation of priority wetlands. The key outputs are an assessment of the conservation status of wetlands in Nevada; the state's list of priority (vulnerable and valuable) wetlands; and, strategies state agencies can employ to conserve priority wetlands.

Nevada Springs Conservation Plan (NVSCP)

The Nevada Natural Heritage Program (NNHP), Desert Research Institute and the Nature Conservancy partnered for the development of the Nevada Springs Conservation Plan. The plan is the culmination of a partnership among the three entities and more than three years of field work, data analysis and conservation planning. Since the mid-1980s, DRI has been gathering information on springs throughout the state and has been documenting the condition of the springs. The springs conservation plan reports on the condition of 283 springs, associated animal species, and recommended conservation actions.

Spring Mountains National Recreation Area Conservation Agreement

The Spring Mountains ecosystem in Clark and Nye Counties has long been recognized as an island of endemism, harboring 25 plant and wildlife species found nowhere else in the world. A conservation agreement for the Spring Mountains National Recreation Area was established in 1998 and in 2000, was incorporated into the Clark County Multiple Species Habitat Conservation Plan (MSHCP). Successful implementation of this conservation agreement and conservation activities under the MSHCP are necessary to ensure the long-term survival of the rare species that occur there.

Amargosa Toad

The agreement and strategy for the Amargosa toad and co-occurring sensitive species in the Oasis Valley of Nye County, Nevada was executed by the partners in September 2000 and has been in the implementation phase since that time.

Columbia Spotted Frog

Conservation agreements and strategies were developed in 2003 for the Toiyabe and Northeast subpopulations of the Great Basin population of the Columbia spotted frog. The agreements and strategies were designed to expedite implementation of conservation measures for the respective subpopulations of the species as a collaborative and cooperative effort among resource agencies, governments, and land owners.

Relict Leopard Frog

The National Park Service is the lead agency for preparing a Conservation Agreement for the species with cooperation from State, County, and Federal partners. Implementation of the conservation agreement and strategy is intended to protect the species and its habitat, implement necessary conservation actions, and preclude listing of this candidate species.

Townsend's Big-eared Bat

In an effort to identify and implement conservation measures for the Townsend's big-eared bat, the Idaho Conservation Effort convened 19 professionals from 10 western states within the native range of the species. The result of this three-year effort was the publication and implementation of Species Conservation Assessment and Conservation Strategy for the Townsend's Big-eared Bat (Pierson et al., 1999). Nevada participated in all aspects of preparation and is currently in the implementation phase of the conservation strategy.

Recovery Implementation Teams

Although the majority of aquatic species of conservation need in Nevada which are listed under the Endangered Species Act (ESA) are included under existing Recovery Plans, these documents are in many cases outdated, do not describe needed actions at a level suitable to direct on-the-ground conservation efforts, or are focused only on recovery needs for the listed species and do not adequately address conservation for the full assemblage of aquatic species which occur in the included habitats. For that reason NDOW and the USFWS, in coordination with other partners, have focused on the development of Recovery Implementation Team (RIT) working groups to more effectively implement conservation and recovery for a number of species and aquatic systems.

The RIT teams are voluntary working groups that meet periodically to assess the status of included species and conservation efforts, review, develop and adaptively modify on-ground conservation actions, and coordinate field efforts. Composed of state and federal agency partners, and also tribes, local entities and non-governmental organizations (NGOs) as appropriate, these implementation level teams have proven to be an effective approach to insure that conservation efforts for the included species (many of which have no formal "recovery team" organized by USFWS) are progressing effectively. In particular, the RIT approach in many cases has allowed managers to take a more ecosystem-based view for all species of concern in included aquatic habitats, rather than the single-species focus common to formal recovery team processes. Key RIT and related teams in Nevada are listed below.

Lahontan Cutthroat Trout Distinct Population Segment Teams

BLM, USFS, USFWS and NDOW participate in the Lahontan Cutthroat Trout Interagency Management Team and Distinct Population Segment teams. Each year members of these teams meet to review accomplishment of the previous year and schedule recovery activities for the current year. These teams are the focal point for decision making on all critical activities concerning the management of Lahontan Cutthroat Trout. Team participation by agency management personnel is essential to the continued success of the process.

White River RIT directs conservation efforts for aquatic species in the upper White River system in White Pine and Nye Counties, including White River spinedace, Preston and Moorman White River springfish, White River speckled dace and White River desert sucker.

Railroad Valley Fishes RIT directs conservation efforts for aquatic species in Railroad Valley, Nye County, including habitats on Duckwater tribal lands. Included species are Railroad Valley springfish and Railroad Valley tui chub.

Big Spring Spinedace RIT directs conservation efforts for Big Spring spinedace in Condor Canyon (upper Meadow Valley Wash), Lincoln County. Unlike some other RIT efforts, this team has a single-species focus for recovery of the spinedace.

Pahranagat Valley Native Fishes RIT directs conservation efforts for aquatic species in Pahranagat Valley, Lincoln County, including Pahranagat roundtail chub, White River and Hiko White River springfish, and Pahranagat speckled dace.

Muddy River RIT directs conservation efforts for aquatic species in the upper Muddy River system, Clark County, including Moapa dace, Moapa White River springfish, Moapa speckled dace, and Virgin River chub.

Lower Virgin River RIT directs conservation efforts for aquatic species in the Virgin River in Clark County, Nevada and Mohave County, Arizona. Included species are Virgin River chub, woundfin, flannelmouth sucker, and desert sucker. The Virgin River RIT was formed to address the need to coordinate conservation efforts in the lower Virgin River basin. This team works closely with the Virgin River Resource Management and Recovery Program which directs conservation efforts for these fishes in the upper Virgin River basin in Washington County Utah, and also the range-wide Virgin River Fishes Recovery Team, to develop and coordinate implementation of conservation efforts within this watershed for endemic aquatic species.

Colorado River has several RIT-like processes that have been developed to supplement the range-wide Colorado River Fishes Recovery Team and coordinate local conservation efforts for endemic fishes in the main-stem Colorado River in Nevada, which includes Lakes Mead and Mohave, and the Colorado River below Davis Dam. The principal working group effort has been the Lake Mohave Native Fish Work Group. Under the leadership of the USBR, this group coordinates interagency cooperative efforts to restore and maintain the adult razorback sucker population in Lake Mohave through collection and rearing to sub-adult size, for repatriation, of wild-spawned larvae from Lake Mohave. The recently organized Colorado River Native Fish Work Group is developing a larger role in coordination partnership efforts in other areas of the lower Colorado River basin, including Lake Mead and areas downstream of Lake Mohave in Nevada, Arizona and California.

Devils Hole Pupfish Recovery Team

Although more of a formal Recovery Team process under the lead of the USFWS, this recently formed team directs conservation efforts for the Devils Hole pupfish at Devil's Hole, Nye County, and also the two extant refuges for this species.

Habitat Conservation Plans (HCPs)

HCPs are prepared to address the loss of or disturbance to endangered species on non-Federal lands. These plans typically describe a conservation program with measures to minimize, mitigate, and avoid impacts to species and their habitats. The USFWS approves the HCPs and issues a take permit under the Endangered Species Act to the non-federal entities responsible for implementing the plan. Many HCPs are regionally or watershed based, and thus involves a suite of partners that work with the HCP applicant to carry out the conservation and mitigation measures included within the plan. In Nevada, there are several existing HCPs and several more under development, all in the southern portion of the state.

Clark County Multiple Species Habitat Conservation Plan (MSHCP) and Clark County Desert Conservation Program (DCP)

The DCP is a multi-partner effort that was initially focused on desert tortoise, but has been expanded to include conservation actions for many other species and habitats. The permit issued by the USFWS for the Clark County MSHCP allows for the loss of 58,680 hectares (145,000 acres) of habitat on non-federal lands over a 30-year period in return for conservation and mitigation measures for desert tortoise and a host of other species, primarily on Federal lands. This MSHCP and DCP are major funding sources for wildlife conservation in Clark County. The DCP devotes some of their focus on development and implementation of conservation management strategies for species covered under the MSHCP and their habitats. The *Southern Nevada Mesquite Woodland Habitat Management Plan and Meadow Valley Wash Ecological Assessment* are examples of two such efforts. http://www.clarkcountynv.gov/Depts/dcp/Pages/CurrentHCP.aspx

Colorado River Multi-Species Conservation Program (MSCP)

The Lower Colorado River MSCP is a multi-agency effort to conserve and recover endangered species, and protect and maintain endangered species and wildlife habitat on the lower Colorado River while ensuring the certainty of existing river water and power operations. The MSCP covers areas up to and including the full-pool elevations of Lakes Mead, Mohave and Havasu and the historical floodplain of the Colorado River from Lake Mead to the United States-Mexico Southerly International Boundary, a distance of about 645 km (400 miles). http://www.lcrmscp.gov/

Southeast Lincoln County Multi-Species Habitat Conservation Plan

This HCP was completed in 2010 and will mitigate primarily for the loss of desert scrub (desert tortoise habitat) on approximately 6,070 hectares (15,000 acres) that will be developed just over the county line in the vicinity of the City of Mesquite. In addition, the HCP addresses the Southwestern Willow Flycatcher habitat within riparian zones within key watersheds and flood control measures within the City of Caliente. http://www.fws.gov/nevada/highlights/comment/slc/index.htm

Virgin River Habitat Conservation Plan

The Virgin River HCP will address the effects of development in and around the City of Mesquite on endangered fishes and birds inhabiting the lower Virgin River. The Virgin River HCP is currently under development through the Virgin River Habitat Conservation and Recovery Program. http://vrhcrp.mesquitenv.gov/

Other Key Plans and Programs

LANDFIRE

A five-year, multi-partner wildland fire, ecosystem, and fuel mapping project. This project will generate consistent, comprehensive maps and data describing vegetation, fire, and fuel characteristics across the United States. These maps are produced at scales fine enough to assist in prioritizing and planning specific hazardous fuel reduction and ecosystem restoration projects. The consistency of LANDFIRE methods ensures that data will be nationally relevant, while the 30-meter grid resolution assures that data can be locally applicable. LANDFIRE meets agency and partner needs for data to support landscape fire management planning, prioritization of fuel treatments, collaboration, community and firefighter protection, and effective resource allocation. LANDFIRE map and data products for much of Nevada should be completed and available to the land management agencies and partners in 2006. http://www.landfire.gov/

Partners In Flight -- North American Land Bird Conservation Plan

The Partners in Flight (PIF) North American Landbird Conservation Plan provides a continental synthesis of priorities and objectives to guide landbird conservation actions at national and international scales. The scope for this Plan is the 448 species of native landbirds that regularly breed in the U.S. and Canada. Fully 100 of these species warrant inclusion on the PIF Watch List, due to a combination of threats to their habitats, declining populations, small population sizes, or limited distributions. Of these, 28 species require immediate action to protect small remaining populations, and 44 more are in need of management to reverse long-term declines.
This Plan also highlights the need for stewardship of the species and landscapes characteristic of each portion of the continent, identifying 158 species (including 66 on the Watch List) that are particularly representative of large avifaunal biomes, and whose needs should be considered in conservation planning. Taken together, the pool of Watch List and Stewardship Species represent the landbirds of greatest continental importance for conservation action.

Nevada Partners In Flight Bird Conservation Plan.

Nevada Partners in Flight is a group of conservation organizations, state and federal agencies, and research institutions. The Nevada Bird Conservation Plan developed by the Nevada Partners in Flight group identifies bird species in Nevada that are declining with objectives and suggested actions for their conservation. One of the goals identified in the Nevada Bird Conservation Plan is to work with private landowners to reverse the decline of these “priority species” by protecting and conserving their habitat.

http://www.gbbo.org/bird_conservation_plan.html

U.S. Shorebird Conservation Plan

Partners from state and federal agencies and non-governmental organizations from across the country pooled their resources and expertise to develop a conservation strategy for migratory shorebirds and the habitats upon which they depend. The plan provides a scientific framework to determine species, sites, and habitats that most urgently need conservation action. The primary goals of the plan are to ensure that adequate quantity and quality of shorebird habitat is maintained at the local level and to maintain or restore shorebird populations at the continental and hemispheric levels. Shorebird conservation strategies for Nevada are found in the Intermountain West Regional Report (Oring et al., 1999).

North American Waterbird Conservation Plan

This plan provides an overarching framework and guide for conserving waterbirds. The Plan sets forth goals and priorities and advocates continent-wide monitoring; provides an impetus for regional conservation planning; proposes national, provincial, state and other local conservation planning and action; and creates a larger context for local habitat conservation. Taken together, these activities should assure healthy populations and habitats for the waterbirds of the Americas. Waterbird conservation strategies for Nevada are found in the Intermountain West Waterbird Conservation Plan (Ivey and Herziger, 2005).

North American Hemispheric Shorebird Reserve Network

In 1988, the Lahontan Valley Wetlands were incorporated into the Western Hemisphere Shorebird Reserve Network. This network provides an international system of linked reserves to protect important sites required by birds throughout their ranges.

North American Waterfowl Management Plan

The North American Waterfowl Management Plan is an international action plan to conserve migratory birds throughout the continent. The Plan's goal is to return waterfowl populations to their 1970s levels by conserving wetland and upland habitat. The Plan is a partnership of federal, provincial/state and municipal governments, non-governmental organizations, private companies and many individuals, all working towards achieving better wetland habitat for the benefit of migratory birds, other wetland-associated species and people. Plan projects are international in scope, but implemented at regional levels.

Swan Lake Nature Study Area

Various public agencies and non-profit organizations established the nature study area on 728 hectares (1,800 acres) of wetlands in Washoe County that provides bird watching opportunities and also serves as an outdoor educational facility for school children and others. A strategic plan was completed in 2011.

Carson Lake Transfer

The Carson Lake property in Churchill County is about 12,140 hectares (30,000 acres) in size with a seasonal wetland of about 3,238 hectares (8,000 acres). It supports thousands of waterfowl during fall migration, and is home to a large variety of shorebirds. Historically, Carson Lake served as the terminus of the Carson River, and is one of the last remnants of ancient Lake Lahontan. After development of the Newlands Project for agricultural irrigation in the Lahontan Valley, the wetland was reduced to about 345 hectares (850 acres). In the years that followed, and until a water rights acquisition program was set into effect, the wetland relied on drain flows from irrigation practices for sustenance. Following the future transfer of Carson Lake to the state, the property will be managed by NDOW as a state wildlife management area. NDOW's management objectives for the area are to preserve and enhance up to 4,130 hectares (10,200 acres) of the shallow wetlands and wet meadows that are unique to the area to benefit all wetland-dependent wildlife species; provide nesting, feeding and resting habitat to meet the needs for a maximum number and variety of migratory and nonmigratory wildlife; and to provide for waterfowl hunting, bird watching, and other forms of public recreation in a manner which is compatible with the area's wildlife and wetland resources.

Bat Conservation

The Nevada Bat Working Group and Western Bat Working Group are comprised of agencies, organizations and individuals interested in bat research, management, and conservation. These groups coordinate with other organizations such as Bat Conservation International, which is devoted to conservation, education, and research initiatives involving bats and the ecosystems they inhabit. The Nevada Bat Conservation Plan was developed by the Nevada Bat Working Group to provide strategic and proactive guidance for managing bat populations and habitats in Nevada. http://www.wbwg.org/aboutus/portals/NVportal.html

Wildlife Rehabilitators

Three non-profit organizations, Northeastern Nevada Wildlife Rehabilitation Clinic, Wild Animal Infirmary for Nevada and Wild Wings provide rehabilitation services for birds of prey and other native species.

APPENDIX C

TNC CLIMATE CHANGE REPORT: ADDITIONAL TABLES AND PRESCRIPTIVE ACTIONS

Class Code Definitions

Table C.1. The following are the descriptions of biophysical settings' vegetation classes for the WAP.

Class Code	*Class abbreviation and brief description*
Alpine 1071	
A	***Early***: 0-10% cover of graminoids; <90% soil cover; 0-2 yrs
B	***Late-closed****:* >11% cover of graminoids and forbs; <10% cover of low shrubs; >2 yrs
Aspen-Mixed Conifer 1061	
A	***Early***; 0-100% cover aspen <5m; mountain snowberry and *ribes* common; 0-19 yrs
B	***Mid-closed***: 40-99% cover aspen <5-10m; mountain snowberry and *ribes* common; 11-39 yrs
C	***Mid-closed***: 40-99% cover aspen 10-24m; conifer saplings visible in mid-story; mountain snowberry and *ribes* common; 40-79 yrs
D	***Late-open***: 0-39% cover aspen 10-25 m; 0-25% montane and subalpine conifer cover 5-10 m; mountain snowberry and *ribes* common; >80 yrs
E	***Late-closed***: 40-80% cover of mixed conifer 10-50m; <40% cover of aspen 10-25m; mountain snowberry and *ribes* present; >100 yrs
Aspen Woodland 1011	
A	***Early***: 0-100% cover of aspen <5m tall; 0-9 yrs
B	***Mid-closed***: 40-99% cover of aspen <5-10m; 10-39 yrs
C	***Late-closed***: 40-99% cover of aspen 10-25m; few conifers in mid-story; >39 yrs
D	***Late-open***: 0-39% cover of aspen 10-25 m; 0-25% conifer cover 10-25 m; >99 yrs
U-DP	***Depleted***: 10-50% cover of older aspen 10-25m; no or little aspen regeneration; few conifers in mid-story
Big Sagebrush Steppe 1125	
A	***Early***: 20-80% grass (Idaho fescue, Thurber's needlegrass, bluebunch wheatgrass) and forb cover; 0-10% canopy of big sagebrush (mountain and Wyoming)/mountain brush; 0-12 yrs;
B	***Mid-open***: 11-30% cover of big sagebrush (mountain and Wyoming)/mountain shrub; >50% grass (Idaho fescue, Thurber's needlegrass, bluebunch wheatgrass) and forb cover; 13-38 yrs
C	***Mid-closed***: 31-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; 25-50% herbaceous cover, <10% conifer sapling cover; 38+ yrs
U-AG	***Annual-Grass***: 10-30% cover of cheatgrass; <10% shrub cover
U-ES	***Early-Shrub***:20-50% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 21-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; if native grass >5% cover, then >5% cover of cheatgrass or if native grass ≤5% cover, then 0-20% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-SD	***Seeded***: >10% cover of seeded herbaceous and/or shrub species, either native, introduced, and mixed native and introduced;<5% cheatgrass cover

Class Code	Class abbreviation and brief description
U-TA	***Tree-Annual-Grass***: 20-80% conifer (pinyon, juniper, or montane conifer) cover; <5% shrub cover; if native grass >5% cover, then >5% cover of cheatgrass or if native grass ≤5% cover, then 0-20% cheatgrass cover; >140 yrs
Big Sagebrush upland (10-14 inch precipitation zone) 10801	
A	***Early***: 10-80% grass/forb cover; 0-10% cover of big sagebrush (mountain and Wyoming)/mountain brush; 0-12 yrs
B	***Mid-open***: 11-30% cover of big sagebrush (mountain and Wyoming)/mountain shrub; >50% herbaceous cover; 13-38 yrs
C	***Mid-closed***: 31-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; 25-50% herbaceous cover, <10% conifer sapling cover; 38+ yrs
D	***Late-open***: 10-30% cover conifer <5m for PJ and <10m for mixed conifers; 25-40% cover of big sagebrush (mountain and Wyoming)/mountain brush; <30% herbaceous cover; 80-129 yrs
E	***Late-closed***: 31-80% conifer cover (lower for PJ, greater for mixed conifers) 10-25m; 6-20% shrub cover; <20% herbaceous cover; 130+ yrs
U-AG	***Annual-Grass***: 10-30% cover of cheatgrass; <10% shrub cover
U-DP	***Depleted***: 20-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; <5% herbaceous cover; <5% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-ES	***Early-Shrub***:20-50% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 21-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; ≥5% cover of native grass; 5-10% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-SA	***Shrub-Annual-Grass***: 21-50% cover of big sagebrush (mountain and Wyoming)/mountain brush; <5% cover of native grass; 5-10% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-SD	***Seeded***: >10% cover of seeded herbaceous and/or shrub species, either native, introduced, and mixed native and introduced; <5% cheatgrass cover
U-TA	***Tree-Annual-Grass***: 31-80% conifer cover 10-25m; <5% shrub cover; <5% herbaceous cover, ≥5% cheatgrass cover; >140 yrs
U-TE	***Tree-Encroached***: 31-80% conifer cover 10-25m; <5% shrub cover; <5% herbaceous cover, <5% cheatgrass cover; >140 yrs
Blackbrush - mesic (>9 inch precipitation zone; BM) 10821	
A	***Early***: 0-40% cover of snakeweed, big sagebrush, turpentine bush, yucca, and desert bitterbrush; young blackbrush may be present; 0-199 yrs
B	***Mid-closed***: 10-50% cover blackbrush <1.0m; >5% cover of young Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present; Joshua trees may be present; pinyon or juniper saplings present; 200+ yrs
C	***Late-closed***: 10-40% of pinyon or juniper; 5-40% blackbrush cover; >5% cover of Joshua trees; <10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present; Joshua trees may be present; 400+ yrs
U-TA	***Tree-Annual-Grass***: 10-40% of pinyon or juniper; >5% cover of non-native grasses; <20% blackbrush cover; Joshua trees may be present
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 10-50% cover of blackbrush or other shrubs <1.0m tall; Joshua trees may be present; 5-20% non-native grass or forb cover; native grass cover may be spotty to common

Class Code	*Class abbreviation and brief description*
U-AG	***Annual-Grass*:** >10% cover of exotic forbs or annual grasses; <10% cover of blackbrush or other shrubs
U-SD	***Seeded***: >10% seeded native or non-native grasses, forbs, and shrubs
U-BG	***Bare ground***: mineral soil exposed by human disturbances
Blackbrush - thermic (≤9 inch precipitation zone; BT) 10820	
A	***Early***: 0-50% cover of snakeweed, turpentine bush, yucca; <10% cover blackbrush; 0-499 yrs
B	***Late-closed***: 500+ yrs; 10-40% cover blackbrush <1.0m; white bursage or creosotebush present; >5% cover of Joshua trees; 0-10% cover of grasses (desert needlegrass, Indian ricegrass, galleta grass, fluff grass, and threeawn); other shrubs present
U-SAP	***Shrub- Annual-Grass-Perennial-Grass*:** 10-40% cover of blackbrush or other shrubs <1.0m tall, 5-20% non-native grass or forb cover; Joshua trees may be present; ≥5% native grass cover
U-AG	***Annual-Grass***: >10% cover of exotic forbs or annual grasses; <10% cover of blackbrush or other shrubs
U-BG	***Bare ground***: mineral soil exposed by human disturbances
Chaparral 1104	
A	***Early***: 10-100% cover of *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii* <3m tall; forbs abundant; 0-10 yrs
B	***Late-closed***: 50-100% cover of *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii* >3m tall; 10+ yrs
U-SAP	***Shrub-Annual-Perennial-Grass***: >5% cheatgrass cover in spaces between shrubs; 10-100% cover of *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii* <3m tall; forbs abundant
Creosotebush-White Bursage Scrub 1087	
A	***Early***: 5-9% cover of creosote and white bursage builds up over time; 5-20% grass cover depending on winter precipitation and season; 0-19 yrs
B	***Late-closed***: 10-40% creosote and white bursage cover; 5-20% grass and forb cover (depending on winter precipitation, soil productivity, and season); Joshua trees may be present; 20+ yrs
U-AG	***Annual-Grass***: >10% cover of annual exotic forbs or grasses; <10% cover of creosotebush, white bursage, or other shrubs
U-BG	***Bare ground***: mineral soil exposed by human disturbances
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 10-40% cover of creosote and white bursage; >5% non-native grass or forb cover; native grass and forb may be present to common (depending on winter precipitation, soil productivity, and season); Joshua trees may be present
Curl-leaf Mountain Mahogany 1062	
A	***Early***: 10-55% cover mountain mahogany seedlings and saplings, 0-2m; mineral soil abundant; grasses and shrubs present but not abundant; 0-19 yrs
B	***Mid-Closed***: 30-45% cover of mountain mahogany, mountain sagebrush, snowberry, and mountain snowberry 2-5m high; 60-59 yrs
C	***Mid-Open***: 0-30% cover mountain mahogany 2-5m; mineral soil abundant; grasses and mountain sagebrush, snowberry, and mountain snowberry common; 20-59 yrs
D	***Late-Open***: 0-30% cover of large diameter mountain mahogany 5-25m; grasses and mountain sagebrush, snowberry, and mountain snowberry common; >60 yrs
E	***Late-Closed***: 30-55% cover of mature mountain mahogany, 5-25m; >49 yrs;

Class Code	*Class abbreviation and brief description*
U-AG	***Annual-Grass***: 5-30% cheatgrass cover; <10% shrub cover
U-TA	***Tree-Annual-Grass***: 10-55% cover of mountain mahogany; 5-20% cheatgrass cover
Greasewood 1153	
A	***Early***: 0-20% herbaceous (inland saltgrass, bottlebrush squirreltail, and alkali sacaton) cover; <5% cover rabbitbrush and resprouting greasewood; 0-5 yrs
B	***Late-closed***: 15-25% greasewood cover; <10% cover other shrubs (rabbitbrush, saltbushes, and budsage); <10% cover of grass (inland saltgrass, bottlebrush squirreltail, and alkali sacaton); >5 yrs
U-AG	***Annual-Grass***: 5-30% non-native annual grass cover; <10% shrub cover
U-SA	***Shrub-Annual-Grass***: 5-25% cover of greasewood; 5-20% non-native grass cover
U-SD	***Seeded***: 5-20% seeded native or introduced species cover
High Elevation Meadow 1145	
A	***Early***: 20-60% cover of diverse tall forbs with a minor graminoid component (*Agastache* spp., *Chamerion* spp., *Erigeron* spp., *Senecio* spp., *Helianthella* spp., *Mertensia* spp., *Penstemon* spp., *Campanula* spp., *Hackelia* spp., *Lupinus* spp., *Solidago* spp., *Ligusticum* spp., *Osmorhiza* spp., *Thalictrum* spp., *Valeriana* spp.,*Balsamorhiza* spp., *Wyethia* spp., *Bromus* spp, *Danthonia* spp., *Deschampsia* spp., *Koeleria* spp., *Elymus* spp., *Phleum* spp., and *Dasiphora* spp.); 40-80% fine textured soil; 0-4 years
B	***Mid-closed***: 60-100% cover of diverse tall forbs with a minor graminoid component; <5% shrub cover; 5-9 years
C	***Late-closed***: 5-10% shrub cover of *Populus tremuloides*, *Arrtemisia cana*, *Artemisia tridentata*, *Rosa woodsii*, *Ribes* spp., *Amelanchier* spp.; 90-95% cover of diverse tall forbs with a minor graminoid component; 10-300 years
U-UF	***Unpalatable Forb***: >60% cover of uncharacteristic forbs usually dominated by *Wyethia* spp.
U-US	***Unpalatable Shrub***: >60% cover of uncharacteristic shrubs dominated by *Artemisia cana* and *Rosa woodsii*.
Jeffrey Pine 1031	
A	***Early***: 0-60% cover of shrub/grass; conifer seedlings can be abundant <5m; 0-39yrs;
B	***Mid-closed***: 40-60% cover of Jeffrey pine, white fir and 5-10m; dense shrub cover possible; 40-159yrs
C	***Mid-open***: 10-39% cover of Jeffrey pine; abundant shrub and grass cover; 40-159yrs
D	***Late-open***: 10-39% cover of Jeffrey pine 11--50m; abundant shrub and grass cover; >160 yrs
E	***Late-closed***: 40-80% cover of Jeffrey pine,11-50m; mountain snowberry common; ; >160 yrs
U-AG	***Annual-Grass***: >10% cheatgrass cover; trees largely absent; charred logs or standing dead trees often present; native grasses and forbs present to abundant
U-TA	***Tree-Annual-Grass***:10-80% cover of young and older Jeffrey pine and white fir; >5% cheatgrass cover; native grass and shrubs present to abundant
Juniper Savanna 1115	
A	***Early***: 10-30% herbaceous cover ; 0-19 yrs
B	***Mid-Open***: 10-30% cover big sage <0.5m tall; 10-40% herbaceous cover; 20-39 yrs
C	***Mid-Closed***: 10-40% shrub cover 0.5-1.0m tall; 11-30% cover of juniper <2m; <20% herbaceous cover; 40-99 yrs

Class Code	*Class abbreviation and brief description*
D	***Late-Open***:10-20% cover of juniper <5m tall; 10-20% shrub cover; <20% herbaceous cover; 100-399 yrs
E	***Late-Closed***:21-40% cover of juniper <10m tall; 10-20% shrub cover; <20% herbaceous cover; >400 yrs
U-AG	***Annual-Grass***: 10-30% non-native annual grass; <10% rabbitbrush or snakeweed cover; charred stumped of juniper evident
U-TA	***Tree-Annual-Grass***: 10-40% cover of juniper; 10-20% shrub cover; <10% herbaceous cover; 5-20% cover of annual grass
Limber-Bristlecone Pine Woodland 1020	
A	***Early***: 0-10% limber and bristlecone pine cover 0-5m high; abundant mineral soil or talus cover; sparse ground cover; 0-99 yrs
B	***Mid-Open***: 11-30% limber and bristlecone pine cover 5-10m high; abundant mineral soil or talus cover; sparse ground cover; 100-249 yrs
C	***Late-Open***: very old trees; 11-30% limber and bristlecone pine cover 5-25m high; abundant mineral soil or talus cover; sparse ground cover; >250 yrs
Low-Black Sagebrush 1079	
A	***Early***: <10% cover rabbitbrush; 10-40% cover of grass; 50-80% cover mineral soil; 0-25 yrs
B	***Mid-open***: 10-20% cover of black sagebrush or low sagebrush and rabbitbrush; 10-30% grass cover; <40% cover of mineral soil; 25-119 yrs
C	***Late-Open***: 20-30% cover of black sagebrush or 10-30% cover of low sagebrush; 10-30% cover of grasses; 1-10% pinyon-juniper sapling cover; 120-194 yrs
D	***Late-Closed***: 10-30% cover of mature pinyon or juniper on black sagebrush sites or 5-20% cover of mature pinyon or juniper on low sagebrush sites; <10% black sagebrush or 5-20% cover of low sagebrush; <10% grass cover; >195 yrs
U-AG	***Annual-Grass***: 10-30% cover of cheatgrass
U-DP	***Depleted***: 20-50% cover of black sagebrush or 10-30% cover of low sagebrush; <5% herbaceous cover; <10% pinyon or juniper sapling cover
U-ES	***Early-Shrub***: 10-40% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 20-50% cover of black sagebrush or 10-30% cover of low sagebrush; >5% cover of native grass; 5-20% cheatgrass cover; <10% pinyon or juniper sapling cover
U-SA	***Shrub-Annual-Grass***: 20-50% cover of black sagebrush or 10-30% cover of low sagebrush; <5% cover of native grass; 5-20% cheatgrass cover; <10% pinyon or juniper sapling cover
U-SD	***Seeded***: 5-20% cover of native or non-native (crested wheatgrass, forage koshia) seed mix; ≤5% cover of annual grass
U-TA	***Tree-Annual-Grass***: >20% pinyon or juniper cover on black sagebrush sites or >10% pinyon or juniper cover on low sagebrush sites 10m; >5% cover of annual grass; <5% shrub cover; <5% herbaceous cover
U-TE	***Tree-Encroached***: >20% pinyon or juniper cover on black sagebrush sites or >10% pinyon or juniper cover on low sagebrush sites; <5% shrub cover; <5% native herbaceous cover; ≤5% cover of annual grass
Low Sagebrush Steppe (>14 inch precipitation zone) 1124	
A	***Early***: 15-25% herbaceous cover (bluebunch wheatgrass, Thurber's needlegrass); 0-10% cover of rabbitbrush; 0-25 yrs

Class Code	Class abbreviation and brief description
B	***Mid-open***: 11-20% cover of low sagebrush and mountain snowberry; 15-25% herbaceous cover (bluebunch wheatgrass, Thurber's needlegrass); 25-99 yrs
C	***Late-Closed***: 21-30% cover of low sagebrush and Utah serviceberry; 10-15% herbaceous cover (bluebunch wheatgrass); >100 yrs
U-DP	***Depleted***: 10-30% cover of low sagebrush; <5% herbaceous cover; <10% pinyon or juniper sapling cover
U-ES	***Early*-Shrub**: 10-40% cover rabbitbrush species
U-TE	***Tree-Encroached***: >10% pinyon, juniper cover, or montane-subalpine conifer; <5% shrub cover; <5% native herbaceous cover; annual grass usually absent
Low Elevation Grassland 1139	
A	***Early***: 10-30% grass cover (*Festuca idahoensis*, *F. compestris*, Pseud*oroegneria spicata*, *Koeleria macratha*); 0-10% cover of forbs (*Colinsia* spp., *Lupinus* spp., *Epilobium* spp., *Balsamorhiza* spp., *Geum* spp., *Potentilla* spp.); 0-4 yrs
B	***Mid-Closed***: 41-80% cover of grass; 10-20% forb cover; shrubs present but low stature; 5-64 yrs
C	***Late-Open***: 11-20% shrub cover (*Symphoricarpus alba* and *Rosa* spp.); 41-80% grass cover; <10% forb cover; >65 yrs
U-AG	***Annual-Grass***; 5-30% cheatgrass cover; <5% shrub cover; native tree cover <5%
U-ES	***Early-Shrub***: 10-40% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: >20% shrub cover; >5% annual grass; <40% herbaceous cover; mineral soil common
U-TA	***Tree-Annual-Grass***: >5% pinyon, juniper cover, or montane conifer; shrub herbaceous cover variable but usually >20%; <41% native grass cover; annual grass may be present, especially under the canopy of trees
Mixed Conifer 1052	
A	***Early***: 0-15% cover of tree/shrub/grass; <5m; 0-29 yrs
B	***Mid-closed***: 35-100% cover of white fir and other conifers <24m; 30-99 yrs
C	***Mid-open***: 0-35% cover of white fir and other conifers <24m; 30-99 yrs
D	***Late-open***: 0-35% cover of white fir and other conifers 25-49m; >100 yrs
E	***Late-closed***: 35-100% cover of white fir and other conifers 25-49m; >100 yrs
U-AG	***Annual-Grass***: >10% cheatgrass cover; <10% shrub cover; trees largely absent; charred logs or standing dead trees often present; native grasses and forbs present to abundant
U-TA	***Tree-Annual-Grass***: 10-80% cover of young and older white fir and other conifers; >5% cheatgrass cover; native grass and shrubs present to abundant
Mixed Salt Desert Scrub 1081	
A	***Early***: 0-5% cover of young *Atriplex* spp. or other shrubs, Indian ricegrass and squirreltail common; 0-5 yrs
B	***Late1*-open**: 5-20% cover *Atriplex* spp. or other shrubs; >6 yrs
C	***Late2*-open**: 5-20% cover budsage <0.25m; >7 years
U-AG	***Annual-Grass***: 5-30% cheatgrass cover; <10% shrub cover
U-SA	***Shrub-Annual-Grass***: 5-20% cover of *Atriplex* spp. or other shrubs; 5-20% cheatgrass cover
U-SD	***Seeded***: native or non-native (crested wheatgrass, forage koshia) seed mix cover 5-20%
Montane Riparian (carbonate or non-carbonate geology) 1154	
A	***Early***: 0-50% cover of cottonwood, willow, Wood's rose <3m; carex present; 0-5 yrs
B	***Mid-open***: 31-100% cover of cottonwood, aspen, willow, Wood's rose <10m; 5-20 yrs;

Class Code	*Class abbreviation and brief description*
C	***Late-closed***: 31-100% cover of cottonwood, alder, aspen, willow 10-24m; >20 yrs
U-EF	***Exotic-Forb***: 5-100% cover of exotic forbs (knapweed, tall whitetop, purple loosestrife, thistle), salt cedar, or Russian olive
U-DE	***Desertification***: Entrenched river/creek with 10-50% cover of upland shrubs (e.g., big sage); cheatgrass absent to common
U-PA	***Pasture***: agricultural pasture
U-SFE	***Shrub-Forb-Encroached***: 10-50% cover of unpalatable shrub and forb species (*Rosa woodsii* and *Rhus trilobata*) in open areas or under tree canopy
Montane Sagebrush Steppe mountain (≥14 inch precipitation zone) 1126m	
A	***Early***: 0-10% canopy of mountain sagebrush/ mountain brush; >50% grass/forb cover; 0-12 yrs
B	***Mid-open***: 11-30% cover of mountain sagebrush / mountain shrub; >50% herbaceous cover; 13-37 yrs
C	***Mid-closed***; 31-50% cover of mountain sagebrush / mountain brush; 25-50% herbaceous cover; <10% conifer sapling cover; >38 yrs
D	***Late-open***: 10-30% cover conifer <10m; 25-40% cover of mountain sagebrush / mountain brush; <30% herbaceous cover; 80-129 yrs
E	***Late-closed***: 31-80% conifer cover 10-25m; 6-20% shrub cover, <20% herbaceous cover; >129 yrs
U-AG	***Annual-Grass***: 10-30% cover of cheatgrass; <10% shrub cover
U-DP	***Depleted***; 20-50% cover of mountain big sagebrush/mountain brush; <10% herbaceous cover; <5% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-ES	***Early-Shrub***: 10-50% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 21-50% cover of mountain big sagebrush/mountain brush; ≥10% cover of native grass; 5-10% cheatgrass cover; <10% conifer sapling cover; >50 yrs
U-TE	***Tree-Encroached***: 31-80% conifer (usually montane conifer and pinyon) cover 10-25m; <5% shrub cover; <5% herbaceous cover; >130 yrs
Mountain Shrub 1086	
A	***Early***: 0-10% canopy of Utah snowberry/antelope bitterbrush; 10-80% grass/forb cover; 0-12 yrs
B	***Mid-open***: 11-30% cover of Utah snowberry/antelope bitterbrush; >50% herbaceous cover; 13-38 yrs
C	***Mid-closed***: 31-50% cover of Utah snowberry/antelope bitterbrush/mountain big sagebrush; 25-50% herbaceous cover, <10% conifer sapling cover; 38+ yrs
D	***Late-open***: 10-20% pinyon pine-white fir cover <5m; 25-40% cover of Utah snowberry/antelope bitterbrush/mountain big sagebrush; <30% herbaceous cover; 80-129 yrs
U-DP	***Depleted***: 20-50% cover of Utah snowberry/antelope bitterbrush/mountain big sagebrush; <5% herbaceous cover; <10% pinyon sapling cover
U-ES	***Early-Shrub***: 20-50% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 20-50% cover of Utah snowberry/antelope bitterbrush/mountain big sagebrush; >5% cover of native grass; 5-10% cheatgrass cover; <10% pinyon sapling cover
U-TE	***Tree-Encroached***: >21% pinyon pine-white fir cover 10-25m; <5% shrub cover; <5% herbaceous cover
Paloverde Mixed Cacti 1109	
A	***Early-open***: 5-30% herbaceous cover dominated by brittlebrush (*Encelia farinosa*); 0-19 yrs

Class Code	*Class abbreviation and brief description*
B	***Mid-open***: 5-30% cover of brittlebrush with woody succulents and woody early-succession plants growing beneath the brittlebrush canopy; 20-94 yrs
C	***Late-closed***: 5-30% cover of white bursage (*Ambrosia dumosa*); 10-30% cover of succulents and small tree-dominated communities (*Carnegiea gigantea*, *Parkinsonia* spp., *Ferocactus* spp., *Fouqueria splendens*, *Acacia greggii*, and *Olneya tesota*); >95 yrs
Pinyon-Juniper 1019	
A	***Early***: 5-20% herbaceous cover; 0-9 yrs
B	***Mid1-open***: 11-20% cover big sage or black sage <1.0m; 10-40% herbaceous cover; 10-29 yrs
C	***Mid2-open***: 11-30% cover of pinyon and/or juniper <5m; 10-40% shrub cover; <20% herbaceous cover; 30-99 yrs
D	***Late-open***: old growth, 31-50% cover of pinyon and/or juniper <5m-9m; 10-40% shrub cover; <20% herbaceous cover; >99 yrs
U-AG	***Annual-Grass***: 5-30% cheatgrass cover; <10% shrub cover
U-TA	***Tree-Annual-Grass***: 31-50% cover of pinyon and/or juniper <5m-9m; 10-40% shrub cover; <20% cheatgrass cover
Ponderosa Pine 1054	
A	***Early***: 0-60% cover of shrub/grass; conifer seedlings can be abundant <5m; 0-39yrs;
B	***Mid-closed***: 31-60% cover of ponderosa pine, Douglass-Fir, and white fir 5-10m; dense shrub cover possible; 40-159yrs
C	***Mid-open***: 10-30% cover of ponderosa pine (dominant), Douglass-Fir, and limber pine 5-10m; abundant shrub and grass cover; 40-159yrs
D	***Late-open***: 10-30% cover of ponderosa pine (dominant), Douglass-Fir, and limber pine 11--50m; abundant shrub and grass cover; >160 yrs
E	***Late-closed***: 31-80% cover of ponderosa pine, Douglass-Fir, and limber pine 11-50m; mountain snowberry common; >160 yrs
U-AG	***Annual-Grass***: >10% cheatgrass cover; trees largely absent; charred logs or standing dead trees often present; native grasses and forbs present to abundant
U-TA	***Tree-Annual-Grass***: 10-80% cover of young and older ponderosa pine and other conifer; >5% cheatgrass cover; native grass and shrubs present to abundant
Semi-Desert Grassland 1135	
A	***Early***: 0-20 yrs; 10-40% cover of grasses (Indian ricegrass and desert needlegrass, and in the Mojave Desert big galleta and bush muhly); <5% shrub cover (spiny menadora)
B	***Mid-closed***: 20+ yrs; >25% cover of grasses (Indian ricegrass and desert needlegrass, and in the Mojave Desert big galleta and bush muhly); 5-25% shrub cover (spiny menadora)
U-DP	***Depleted***: 5-30% shrub cover; <10% cover of grasses; 10-30% bare ground cover
U-ES	***Early-Shrub***: 10-30% cover of rabbitbrush; 10-30% bare ground cover; <10% native grass cover
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 5-30% shrub cover; 5-15% cover of annual grasses; native grasses may be present to common
Spruce-Fir 1056	
A	***Early***: 0-100% cover of Engelman spruce seedling/shrub/grass <5m; 0-39 yrs
B	***Mid1-closed***: 40-100% cover of Engelman spruce and aspen 5-24m; 40-129yrs
C	***Mid1-open***: 0-40% cover of Engelman spruce 5-24m pole size; ; 40-129yrs
D	***Late-closed***: 40-100% cover of Engelman spruce 25-49m; >129 yrs

Class Code	Class abbreviation and brief description
	Subalpine Riparian 1160
A	***Early***: 0-50% cover of willow, <3m; large patches of basin wildrye, sedges, and tufted grasses; 0-2 yrs
B	***Mid-open***: 10-30% cover of mixed conifers 0-5m; aspen and willow abundant; large patches of basin wildrye, sedges, and tufted grasses; 3-22 yrs
C	***Late-closed***: 31-50% cover of mixed conifers 5-10m; aspen and willow abundant; >22 yrs
U-EF	***Exotic-Forbs***: >5% of thistle or other exotic forbs (tall whitetop, Russian knapweed, purple loosestrife); native woody shrubs and trees present to abundant; graminoids dominated patches may be presernt
	Warm Desert Riparian (WDR) 11550
A	***Early***: 10-50% cover of Gooding willow and Fremont Cottonwood seedlings and shrubs; riparian and wetland graminoids may co-dominate; 0-4 yrs post-flooding
B	***Mid-closed***: 51-100% cover of willow and small trees (willow and cottonwood) <3 m; patches of graminoids and halophytic shrubs common; 5-19 yrs after flooding
C	***Mid-open***: 11-50% cover of fire resprouts of mesquite and Gooding willow; patches of graminoids frequent after fire; mesquite mature to larger trees several years after fire; 1-89 yrs after fire
D	***Late1-closed***: 51%-90% of mature Gooding willow and Fremont cottonwood; patches of graminoids in saturated soils and of halophytic shrubs on drier sediment deposits or more saline surfaces; 10-89 yrs
E	***Late2-closed***: 51-90% mesquite cover; Gooding willow and Fremont cottonwood minor component; understory often dominated by graminoids and forbs; >90 yrs
U-DE	***Desertified*:** incised river bank caused by human disturbance; 10-90% native halophytic shrub or riparian tree cover; graminoid patches may be present
U-EF	***Exotic Forb***: >5% exotic forb species regardless of native cover; river bank not incised
U-ET	***Exotic-Tree***: >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank not incised
U-DEF	***Desertified-Exotic-Forb***: >5% exotic forb species regardless of native cover; river bank incised
U-DET	***Desertified-Exotic-Tree***: >5% exotic tree species (tamarisk or Russian olive) regardless of native cover; river bank incised
	Washes 11551
A	***Early***: 20-50% cover may be gravel, sands, and/or flood debris; 10-19% cover of shrubs (species varies between southern and northern Nevada: desert almond, burrobrush, rabbitbrush, creosotebush, desert willows present); 5-15% cover of grasses (species varies between southern and northern Nevada); 0-5 yrs
B	***Mid-closed:*** 20-50% cover of shrubs (species varies between southern and northern Nevada: desert almond, bursage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush); 5-10% cover of grasses (species varies between southern and northern Nevada); <30% of gravel and rocks; 5-19 yrs
C	***Late-closed***: 30-50% cover of shrubs (species varies between southern and northern Nevada: bursage, burrobrush, creosotebush, Anderson's wolfberry, rabbitbrush, mesquite); Joshua tree may be present in southern Nevada; 5-10% cover of grasses (species varies between southern and northern Nevada), <10% of gravel and rocks; >20 yrs
U-ET	***Exotic-Tree*:** >5% cover of salt cedar; 0-50% cover of shrubs

Class Code	*Class abbreviation and brief description*
Wyoming Big Sagebrush (8-10 inch precipitation zone) 10800	
A	***Early***: 20-40% herbaceous cover; <10% cover of rabbitbrush species and Wyoming big sagebrush; 0-19 yrs
B	***Mid-open***: 11-20% cover Wyoming big sagebrush; 10-40% herbaceous cover; 20-59 yrs
C	***Late-closed***: 20-40% cover of Wyoming big sagebrush; <20% native herbaceous cover; 60-99 yrs
U-AG	***Annual-Grass***: 10-40% cover of cheatgrass; <10% shrub cover
U-ES	***Early-Shrub***; 20-50% cover rabbitbrush species
U-SAP	***Shrub-Annual-Grass-Perennial-Grass***: 10-30% Wyoming big sagebrush <0.5m, if >5% native grass cover, then >5% cover cheatgrass or if ≤5% native grass cover, then 0-20% cheatgrass cover; >10 yrs
U-TA	***Tree-Annual-Grass***: 11-60% cover of trees 5-9m; <20% cheatgrass cover; >125 yrs

Habitat Support Tables

➢ ***Intermountain Cold Desert Shrub***

Table C.2. Uncharacteristic Class Percentages And Percent Increase In Annual Grass Class By Region For Mixed Salt Desert.

Region	*Current % U-Class*	*%U-Class No CC*	*%U-Class CC no mgmt*	*%change in Annual Grass Class*
Black Rock	72%	80%	76%	17%
Calcareous	44%	59%	54%	24%
Clover	51%	62%	60%	26%
E Sierra	5%	28%	26%	11%
Elko	35%	53%	56%	-7%
Eureka	40%	60%	48%	10%
Humboldt	66%	76%	70%	23%
Lahontan	45%	61%	55%	22%
Mojave	8%	29%	35%	16%
Owyhee	4%	35%	26%	6%
Toiyabe	12%	33%	34%	13%
Tonopah	1%	25%	24%	7%
Walker	3%	26%	26%	9%

Table C.3. Uncharacteristic Class Percentages and Percent Increase in Annual Grass Class By Region For Greasewood.

Region	*Current % U-Class*	*%U-Class No CC*	*%U-Class CC no mgmt*	*%change in Annual Grass Class*
Black Rock	57%	71%	68%	27%
Calcareous	25%	45%	46%	19%
Clover	31%	52%	53%	18%
E Sierra	4%	27%	24%	7%
Elko	35%	53%	48%	3%

Eureka	41%	60%	56%	18%
Humboldt	34%	53%	52%	19%
Lahontan	18%	42%	41%	16%
Mojave	2%	26%	37%	13%
Owyhee	3%	35%	25%	7%
Toiyabe	7%	30%	35%	12%
Tonopah	1%	25%	26%	7%
Walker	1%	25%	27%	8%

- ***Mojave Desert Scrub***

Table C.4. Acres of New Creosote-Bursage in Regions Adjacent (North) to the Mojave.

Region	***Low-High Acres Of New Creosote-Bursage Created In 50 Years***
Calcareous	1350-7100 A
Eureka	0-1400 A
Toiyabe	0-8400 A
Tonopah	18350-30400 A
Walker	350-18000 A

Table C.5. Acres of New Creosote-Bursage *Annual Grass* in Regions Adjacent (North) to the Mojave.

Region	***Low-High Acres Of New Creosote-Bursage Annual Grass Created In 50 Years***
Calcareous	79800-188000 A
Eureka	28000-47900 A
Toiyabe	37600-72500 A
Tonopah	37650-64250 A
Walker	48600-130350 A
Total	187910-503000 A

- ***Warm Desert Riparian***

Table C.6. Vegetation Class Percentages for Warm Desert Riparian.

Region	***Class***	***Description***	***Reference***	***Initial***	***No CC***	***CC no Mgmt***	***Acres CC no Mgmt***
Clover							
	WDR-A:AL	early	9%	41%	30%	40%	172
	WDR-B:CL	mid-closed	16%	59%	25%	30%	129
	WDR-C:OP	mid-open	16%	0%	0%	0%	0
	WDR-D:CL	late1-closed	35%	0%	0%	5%	22
	WDR-E:CL	late2-closed	24%	0%	10%	0%	0
	WDR-U:DE	desertification	0%	0%	0%	0%	0
	WDR-U:DEF	desertified-exotic forb	0%	0%	0%	0%	0
	WDR-U:DET	desertified-exotic tree	0%	0%	0%	0%	0

	WDR-U:EF	exotic-forb	0%	0%	5%	10%	43
	WDR-U:ET	exotic-tree	0%	0%	30%	15%	65
Mojave							
	WDR-A:AL	early	9%	59%	0%	0%	0
	WDR-B:CL	mid-closed	16%	25%	0%	0%	0
	WDR-C:OP	mid-open	16%	3%	0%	0%	0
	WDR-D:CL	late1-closed	35%	2%	0%	0%	0
	WDR-E:CL	late2-closed	24%	0%	0%	0%	0
	WDR-U:DE	desertification	0%	1%	46%	50%	75110
	WDR-U:DEF	desertified-exotic forb	0%	0%	17%	17%	26111
	WDR-U:DET	desertified-exotic tree	0%	4%	20%	21%	30981
	WDR-U:EF	exotic-forb	0%	0%	7%	4%	6052
	WDR-U:ET	exotic-tree	0%	4%	10%	8%	12244
Tonopah							
	WDR-A:AL	early	9%	84%	0%	0%	0
	WDR-B:CL	mid-closed	16%	16%	0%	0%	0
	WDR-C:OP	mid-open	16%	0%	0%	0%	0
	WDR-D:CL	late1-closed	35%	0%	0%	0%	0
	WDR-E:CL	late2-closed	24%	0%	0%	0%	0
	WDR-U:DE	desertification	0%	0%	50%	62%	17729
	WDR-U:DEF	desertified-exotic forb	0%	0%	16%	10%	2924
	WDR-U:DET	desertified-exotic tree	0%	0%	17%	12%	3551
	WDR-U:EF	exotic-forb	0%	0%	9%	6%	1787
	WDR-U:ET	exotic-tree	0%	0%	8%	9%	2437

- ***Sagebrush***

Table C.7. Gains in Big Sagebrush Steppe (Acres) by Region.

Region	*New Acres Big Sagebrush Steppe in 50 Years*	*Average of Five Modeling Replications*
Calcareous Ranges	28000-32400	29800
Eastern Sierra	9200-12200	11100
Eureka	24800-28800	26000
Humboldt Ranges	8700-9700	9100
Lahontan Basin	12000-15000	14400
Toiyabe	43200-52800	47700
Tonopah	14600-17700	16300
Walker Corridor	4600-7900	6000

Table C.8. Percentage of Low-Black Sagebrush BpS in Uncharacteristic Classes by Region.

Region	*Initial*	*No CC*	*CC no Mgmt*	*Increase in U-Classes*
Black Rock	21%	34%	0%	13%

Calcareous	64%	79%	68%	15%
Clover	74%	86%	0%	12%
E. Sierra	30%	50%	0%	20%
Elko	62%	65%	57%	3%
Eureka	21%	46%	0%	25%
Humboldt	43%	66%	0%	23%
Lahontan	54%	75%	50%	21%
Mojave	50%	97%	0%	47%
Owyhee	17%	29%	0%	12%
Toiyabe	22%	52%	0%	30%
Tonopah	28%	61%	0%	33%
Walker	17%	54%	33%	37%

Table C.9. Percentage of Low Sagebrush Steppe BpS in Uncharacteristic Classes By Region.

Region	*Initial*	*No CC*	*CC no Mgmt*	*Increase in U-Classes*
Black Rock	3%	15%	15%	12%
Calcareous	71%	73%	74%	
Clover	70%	81%	84%	14%
Elko	2%	7%	7%	
Eureka	82%	80%	100%	18%
Humboldt	62%	0%	0%	lost
Owyhee	0%	4%	3%	
E Sierra	60%	58%	63%	
Toiyabe	85%	100%	100%	15%

Table C.10. Percentage of Montane Sagebrush Steppe Mountain BpS in Uncharacteristic Classes By Region.

Region	*Initial*	*CC no Mgmt*	*CC w Mgmt*	*Increase in U Classes*
Black Rock	41%	51%		10%
Calcareous	21%	50%	29%	29%
Clover	18%	56%		38%
E. Sierra	22%	37%		15%
Elko	37%	48%	50%	11%
Eureka	31%	45%		14%
Humboldt	57%	68%		11%
Lahontan	81%	77%	66%	
Mojave	33%	94%		61%
Owyhee	17%	24%		
Toiyabe	25%	46%		21%
Tonopah	22%	53%		29%
Walker	28%	55%		27%

Table C.11. Predicted Loss of Montane Sagebrush Steppe Mountain BpS In 50 Years With Climate Change By Region.

Region	***Current Acres***	***Acres in 50 yrs w Climate Change***	***Acres Lost***	***percent loss of current***
Black Rock	1518593	1248873	269720	18%
Calcareous	1765168	1384481	380687	22%
Clover	55824	43598	12226	22%
E. Sierra	584318	458184	126134	22%
Elko	1195612	1023545	172067	14%
Eureka	1539183	1206152	333031	22%
Humboldt	529202	427037	102165	19%
Lahontan	817159	663575	153584	19%
Mojave	8761	7699	1062	12%
Owyhee	115014	89815	25200	22%
Toiyabe	2989534	2366072	623462	21%
Tonopah	980187	768313	211874	22%
Walker	375830	297305	78526	21%

Table C.12. Percentage of Wyoming Big Sage BpS in Uncharacteristic Classes By Region.

Region	***Initial***	***CC no mgmt***	***CC w mgmt***	***Increase in U Classes***
Black Rock	89%	91%		
Calcareous	87%	94%	93%	
Clover	90%	96%		
E. Sierra	59%	69%		10%
Elko	53%	58%	70%	
Eureka	62%	77%		15%
Humboldt	78%	90%		12%
Lahontan	89%	95%	60%	
Mojave	0%	0%		
Owyhee	1%	35%		34%
Toiyabe	89%	90%		
Tonopah	89%	93%		
Walker	77%	83%	18%	

➢ *Aspen*

Table C.13. Distribution of Aspen-Mixed Conifer among Characteristic Classes In Three Primary Nevada Regions.

Region	*Class*	*Description*	*Reference*	*Initial*	*CC no mgt*	*CC w mgt*	*%loss*
Black Rock	ASM-A:AL	early	19%	62%	12%		
	ASM-A:FD	early	0%	0%	0%		
	ASM-B:CL	mid-closed	45%	8%	60%		
	ASM-C:CL	mid-closed	26%	1%	5%		
	ASM-D:OP	late-open	5%	28%	19%		
	ASM-E:CL	late-closed	6%	0%	3%		12%
Calcareous	ASM-A:AL	early	17%	9%	15%	39%	
	ASM-A:FD	early	0%	0%	0%	0%	
	ASM-B:CL	mid-closed	44%	4%	20%	39%	
	ASM-C:CL	mid-closed	25%	6%	5%	4%	
	ASM-D:OP	late-open	5%	0%	7%	3%	
	ASM-E:CL	late-closed	9%	80%	53%	14%	20%
Elko	ASM-A:AL	early	19%	0%	10%	4%	
	ASM-A:FD	early	0%	0%	0%	0%	
	ASM-B:CL	mid-closed	45%	0%	13%	37%	
	ASM-C:CL	mid-closed	26%	0%	0%	43%	
	ASM-D:OP	late-open	5%	0%	3%	16%	
	ASM-E:CL	late-closed	6%	100%	74%	0%	16%

Table C.14. Uncharacteristic Class Percentages And Percent Aspen Loss By Region For Aspen Woodland.

Region	*Current % U-Class*	*% U-Class no CC*	*% U-Class with CC no mgt*	*% aspen loss*
Black Rock	87%	19%	40%	12%
Calcareous	51%	17%	21%	21%
Clover	93%	30%	37%	31%
E Sierra	27%	11%	18%	8%
Elko	69%	25%	41%	17%
Eureka	44%	7%	15%	29%
Humboldt	65%	12%	27%	19%
Lahontan	35%	7%	15%	19%
Owyhee	80%	0%	0%	+21*
Toiyabe	30%	7%	11%	12%
Tonopah	7%	0%	4%	3%
Walker	32%	0%	0%	100%

**+21% gain in Owyhee Region is not supported by a transition pathway; considered an anomaly of small sample size and high standard error.*

➢ ***Lower Montane Woodlands & Chaparral***

Table C.15. Vegetative Class Percentages for Pinyon-Juniper.

Region	*Class*	*Description*	*Reference*	*Initial*	*No CC*	*CC No Mgmt*	*CC W Mgmt*
Black Rock	PJ-A:AL	early	3%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	11%	5%	1%	
	PJ-C:OP	mid2-open	20%	43%	29%	26%	
	PJ-D:OP	late-open	71%	27%	38%	51%	
	PJ-U:AG	annual grass	0%	6%	10%	3%	
	PJ-U:TA	tree-annual grass	0%	14%	14%	17%	
Calcareous	PJ-A:AL	early	2%	0%	3%	0%	23%
	PJ-B:OP	mid1-open	6%	0%	4%	2%	37%
	PJ-C:OP	mid2-open	19%	18%	13%	10%	0%
	PJ-D:OP	late-open	73%	82%	74%	82%	0%
	PJ-U:AG	annual grass	0%	0%	1%	0%	0%
	PJ-U:TA	tree-annual grass	0%	0%	5%	6%	0%
Clover	PJ-A:AL	early	2%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	0%	4%	2%	
	PJ-C:OP	mid2-open	19%	18%	12%	9%	
	PJ-D:OP	late-open	73%	80%	75%	82%	
	PJ-U:AG	annual grass	0%	0%	1%	0%	
	PJ-U:TA	tree-annual grass	0%	1%	5%	6%	
E Sierra	PJ-A:AL	early	2%	6%	4%	1%	30%
	PJ-B:OP	mid1-open	6%	3%	7%	2%	31%
	PJ-C:OP	mid2-open	20%	57%	36%	35%	6%
	PJ-D:OP	late-open	72%	32%	47%	57%	0%
	PJ-U:AG	annual grass	0%	1%	2%	0%	14%
	PJ-U:TA	tree-annual grass	0%	0%	4%	4%	0%
Elko	PJ-A:AL	early	3%	1%	3%	1%	
	PJ-B:OP	mid1-open	6%	37%	13%	8%	
	PJ-C:OP	mid2-open	20%	38%	43%	49%	
	PJ-D:OP	late-open	71%	8%	20%	27%	
	PJ-U:AG	annual grass	0%	11%	13%	7%	
	PJ-U:TA	tree-annual grass	0%	5%	7%	8%	
Eureka	PJ-A:AL	early	2%	0%	2%	0%	
	PJ-B:OP	mid1-open	6%	5%	5%	2%	
	PJ-C:OP	mid2-open	19%	36%	21%	19%	
	PJ-D:OP	late-open	73%	49%	55%	65%	
	PJ-U:AG	annual grass	0%	2%	5%	1%	
	PJ-U:TA	tree-annual grass	0%	9%	12%	13%	
Humboldt	PJ-A:AL	early	2%	0%	2%	0%	

	PJ-B:OP	mid1-open	6%	1%	6%	1%	
	PJ-C:OP	mid2-open	19%	38%	18%	16%	
	PJ-D:OP	late-open	73%	42%	51%	61%	
	PJ-U:AG	annual grass	0%	1%	7%	1%	
	PJ-U:TA	tree-annual grass	0%	17%	17%	20%	
Lahontan	PJ-A:AL	early	2%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	2%	6%	2%	
	PJ-C:OP	mid2-open	19%	51%	23%	21%	
	PJ-D:OP	late-open	73%	32%	48%	59%	
	PJ-U:AG	annual grass	0%	1%	6%	1%	
	PJ-U:TA	tree-annual grass	0%	14%	15%	17%	
Mojave	PJ-A:AL	early	2%	0%	3%	0%	17%
	PJ-B:OP	mid1-open	3%	19%	6%	2%	53%
	PJ-C:OP	mid2-open	13%	44%	34%	33%	24%
	PJ-D:OP	late-open	82%	36%	52%	58%	0%
	PJ-U:AG	annual grass	0%	0%	1%	0%	6%
	PJ-U:TA	tree-annual grass	0%	1%	4%	7%	0%
Owyhee	PJ-A:AL	early	3%	0%	10%	0%	
	PJ-B:OP	mid1-open	6%	2%	0%	0%	
	PJ-C:OP	mid2-open	20%	37%	20%	30%	
	PJ-D:OP	late-open	71%	30%	20%	30%	
	PJ-U:AG	annual grass	0%	1%	0%	0%	
	PJ-U:TA	tree-annual grass	0%	30%	50%	40%	
Toiyabe	PJ-A:AL	early	2%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	1%	3%	2%	
	PJ-C:OP	mid2-open	19%	21%	13%	12%	
	PJ-D:OP	late-open	73%	77%	75%	79%	
	PJ-U:AG	annual grass	0%	0%	1%	0%	
	PJ-U:TA	tree-annual grass	0%	1%	5%	7%	
Tonopah	PJ-A:AL	early	2%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	1%	6%	2%	
	PJ-C:OP	mid2-open	19%	30%	14%	14%	
	PJ-D:OP	late-open	73%	68%	71%	79%	
	PJ-U:AG	annual grass	0%	0%	1%	0%	
	PJ-U:TA	tree-annual grass	0%	0%	4%	5%	
Walker	PJ-A:AL	early	2%	0%	3%	0%	
	PJ-B:OP	mid1-open	6%	2%	4%	3%	
	PJ-C:OP	mid2-open	19%	37%	19%	17%	
	PJ-D:OP	late-open	73%	60%	68%	74%	
	PJ-U:AG	annual grass	0%	0%	1%	0%	

	PJ-U:TA	tree-annual grass	0%	1%	6%	6%	

Table C.16. Vegetative Class Percentages for Juniper Savanna.

Region	Class	Description	Initial	No CC	CC no mgmt	CC w mgmt
Calcareous	JUN-A:OP	early	3%	0%	2%	1%
	JUN-B:OP	mid-open	4%	0%	3%	3%
	JUN-C:OP	mid-closed	11%	0%	3%	2%
	JUN-D:OP	late-open	50%	98%	78%	73%
	JUN-E:OP	late-closed	33%	2%	9%	15%
	JUN-U:AG	annual grass	0%	0%	1%	0%
	JUN-U:TA	tree-annual grass	0%	0%	4%	6%
Elko	JUN-A:OP	early	3%	0%	2%	0%
	JUN-B:OP	mid-open	4%	0%	2%	1%
	JUN-C:OP	mid-closed	11%	36%	18%	22%
	JUN-D:OP	late-open	50%	16%	27%	29%
	JUN-E:OP	late-closed	33%	0%	3%	2%
	JUN-U:AG	annual grass	0%	0%	8%	3%
	JUN-U:TA	tree-annual grass	0%	48%	40%	44%
Mojave	JUN-A:OP	early	3%	0%	0%	0%
	JUN-B:OP	mid-open	4%	0%	0%	0%
	JUN-C:OP	mid-closed	11%	2%	10%	30%
	JUN-D:OP	late-open	50%	23%	0%	0%
	JUN-E:OP	late-closed	33%	75%	90%	70%
	JUN-U:AG	annual grass	0%	0%	0%	0%
	JUN-U:TA	tree-annual grass	0%	0%	0%	0%

Table C.17. Vegetative Class percentages for Mountain Mahogany.

Region	Class	Description	Reference	Initial	No CC	CC no mgmt
Black Rock	MM-A:AL	early	8%	3%	8%	2%
	MM-B:OP	mid-closed	11%	1%	9%	6%
	MM-C:CL	mid-open	14%	8%	4%	5%
	MM-D:OP	late-open	11%	71%	57%	64%
	MM-E:CL	late-closed	57%	15%	16%	18%
	MM-U:AG	annual grass	0%	0%	1%	0%
	MM-U:TA	tree-annual grass	0%	1%	5%	5%
Calcareous	MM-A:AL	early	7%	39%	19%	3%
	MM-B:OP	mid-closed	11%	19%	17%	15%
	MM-C:CL	mid-open	14%	15%	30%	42%
	MM-D:OP	late-open	10%	5%	8%	10%
	MM-E:CL	late-closed	58%	22%	24%	27%
	MM-U:AG	annual grass	0%	0%	0%	0%

	MM-U:TA	tree-annual grass	0%	0%	2%	2%
Clover	MM-A:AL	early	7%	26%	8%	0%
	MM-B:OP	mid-closed	11%	29%	18%	16%
	MM-C:CL	mid-open	14%	17%	40%	45%
	MM-D:OP	late-open	10%	5%	7%	8%
	MM-E:CL	late-closed	58%	19%	20%	23%
	MM-U:AG	annual grass	0%	4%	5%	8%
	MM-U:TA	tree-annual grass	0%	0%	2%	0%
E Sierra	MM-A:AL	early	8%	51%	20%	11%
	MM-B:OP	mid-closed	12%	2%	17%	18%
	MM-C:CL	mid-open	13%	9%	24%	28%
	MM-D:OP	late-open	12%	28%	25%	29%
	MM-E:CL	late-closed	55%	11%	12%	13%
	MM-U:AG	annual grass	0%	0%	1%	0%
	MM-U:TA	tree-annual grass	0%	0%	2%	1%
Elko	MM-A:AL	early	8%	5%	8%	2%
	MM-B:OP	mid-closed	11%	26%	12%	9%
	MM-C:CL	mid-open	14%	21%	21%	29%
	MM-D:OP	late-open	11%	8%	12%	13%
	MM-E:CL	late-closed	57%	0%	7%	8%
	MM-U:AG	annual grass	0%	1%	11%	4%
	MM-U:TA	tree-annual grass	0%	38%	29%	35%
Eureka	MM-A:AL	early	7%	31%	7%	3%
	MM-B:OP	mid-closed	11%	2%	18%	15%
	MM-C:CL	mid-open	14%	26%	21%	26%
	MM-D:OP	late-open	10%	19%	20%	21%
	MM-E:CL	late-closed	58%	20%	27%	30%
	MM-U:AG	annual grass	0%	0%	1%	1%
	MM-U:TA	tree-annual grass	0%	3%	5%	4%
Humboldt	MM-A:AL	early	7%	16%	12%	2%
	MM-B:OP	mid-closed	11%	1%	14%	9%
	MM-C:CL	mid-open	14%	34%	17%	23%
	MM-D:OP	late-open	10%	40%	36%	42%
	MM-E:CL	late-closed	58%	4%	15%	15%
	MM-U:AG	annual grass	0%	0%	3%	2%
	MM-U:TA	tree-annual grass	0%	5%	4%	7%
Lahontan	MM-A:AL	early	7%	15%	16%	1%
	MM-B:OP	mid-closed	11%	2%	15%	13%
	MM-C:CL	mid-open	14%	57%	18%	26%
	MM-D:OP	late-open	10%	19%	24%	27%

	MM-E:CL	late-closed	58%	5%	24%	30%
	MM-U:AG	annual grass	0%	0%	1%	1%
	MM-U:TA	tree-annual grass	0%	1%	3%	3%
Mojave	MM-A:AL	early	21%	82%	0%	30%
	MM-B:OP	mid-closed	43%	6%	40%	31%
	MM-C:CL	mid-open	28%	6%	60%	11%
	MM-D:OP	late-open	3%	0%	0%	0%
	MM-E:CL	late-closed	5%	2%	0%	0%
	MM-U:AG	annual grass	0%	3%	0%	28%
	MM-U:TA	tree-annual grass	0%	1%	0%	0%
Toiyabe	MM-A:AL	early	7%	25%	8%	3%
	MM-B:OP	mid-closed	11%	1%	14%	14%
	MM-C:CL	mid-open	14%	23%	17%	20%
	MM-D:OP	late-open	10%	15%	16%	17%
	MM-E:CL	late-closed	58%	36%	42%	43%
	MM-U:AG	annual grass	0%	0%	0%	0%
	MM-U:TA	tree-annual grass	0%	0%	2%	4%
Tonopah	MM-A:AL	early	7%	21%	12%	2%
	MM-B:OP	mid-closed	11%	1%	9%	7%
	MM-C:CL	mid-open	14%	6%	11%	16%
	MM-D:OP	late-open	10%	4%	3%	4%
	MM-E:CL	late-closed	58%	68%	62%	69%
	MM-U:AG	annual grass	0%	0%	1%	1%
	MM-U:TA	tree-annual grass	0%	0%	2%	1%
Walker	MM-A:AL	early	7%	29%	0%	0%
	MM-B:OP	mid-closed	11%	1%	0%	0%
	MM-C:CL	mid-open	14%	55%	0%	0%
	MM-D:OP	late-open	10%	5%	0%	0%
	MM-E:CL	late-closed	58%	9%	0%	0%
	MM-U:AG	annual grass	0%	0%	0%	0%
	MM-U:TA	tree-annual grass	0%	1%	0%	0%

Table C.18. Vegetative Class Percentages for Chaparral.

Region	*Class*	*Description*	*Reference*	*Initial*	*No CC*	*CC No Mgmt*	*CC W Mgmt*
Calcareous	Chp-A:AL	early	16%	1%	16%	9%	0%
	Chp-B:CL	late-closed	84%	99%	60%	63%	20%
	Chp-U:SAP	shrub-annual-perennial	0%	0%	24%	28%	0%
Clover	Chp-A:AL	early	16%	5%	18%	5%	
	Chp-B:CL	late-closed	84%	94%	58%	69%	
	Chp-U:SAP	shrub-annual-perennial	0%	0%	24%	26%	

E Sierra	Chp-A:AL	early	17%	57%	20%	14%	0%
	Chp-B:CL	late-closed	83%	31%	47%	52%	80%
	Chp-U:SAP	shrub-annual-perennial	0%	13%	33%	34%	0%
Eureka	Chp-A:AL	early	16%	78%	0%	0%	
	Chp-B:CL	late-closed	84%	21%	80%	80%	
	Chp-U:SAP	shrub-annual-perennial	0%	2%	20%	20%	
Lahontan	Chp-A:AL	early	16%	76%	18%	8%	
	Chp-B:CL	late-closed	84%	9%	40%	53%	
	Chp-U:SAP	shrub-annual-perennial	0%	14%	42%	38%	
Mojave	Chp-A:AL	early	16%	54%	23%	8%	19%
	Chp-B:CL	late-closed	84%	46%	77%	92%	81%
	Chp-U:SAP	shrub-annual-perennial	0%	0%	1%	1%	0%
Toiyabe	Chp-A:AL	early	16%	90%	0%	0%	
	Chp-B:CL	late-closed	84%	9%	0%	0%	
	Chp-U:SAP	shrub-annual-perennial	0%	1%	0%	0%	
Tonopah	Chp-A:AL	early	16%	88%	18%	7%	
	Chp-B:CL	late-closed	84%	12%	55%	67%	
	Chp-U:SAP	shrub-annual-perennial	0%	0%	26%	26%	

Table C.19. Vegetative Class Percentages for Mountain Shrub.

Region	*Class*	*Description*	*Ref*	*Initial*	*No CC*	*CC no Mgt*	*CC w Mgt*
Black Rock	MSh-A:AL	early	7%	70%	7%	3%	
	MSh-B:CL	mid-open	24%	21%	22%	14%	
	MSh-C:CL	mid-closed	39%	4%	46%	66%	
	MSh-D:OP	late-open	30%	0%	1%	0%	
	MSh-U:DP	depleted	0%	0%	7%	3%	
	MSh-U:ES	early shrub	0%	0%	8%	3%	
	MSh-U:SAP	shrub-annual-perennial	0%	5%	10%	11%	
	MSh-U:TE	tree-encroached	0%	0%	0%	0%	
Calcareous	MSh-A:AL	early	7%	8%	5%	2%	12%
	MSh-B:CL	mid-open	23%	9%	13%	4%	20%
	MSh-C:CL	mid-closed	40%	60%	23%	21%	30%
	MSh-D:OP	late-open	30%	0%	9%	13%	17%
	MSh-U:DP	depleted	0%	0%	6%	10%	4%
	MSh-U:ES	early shrub	0%	0%	11%	10%	6%
	MSh-U:SAP	shrub-annual-perennial	0%	16%	25%	30%	10%
	MSh-U:TE	tree-encroached	0%	7%	8%	10%	2%
Clover	MSh-A:AL	early	7%	9%	5%	1%	
	MSh-B:CL	mid-open	23%	42%	6%	4%	
	MSh-C:CL	mid-closed	40%	40%	17%	16%	
	MSh-D:OP	late-open	30%	0%	3%	3%	

	MSh-U:DP	depleted	0%	0%	22%	36%	
	MSh-U:ES	early shrub	0%	0%	23%	16%	
	MSh-U:SAP	shrub-annual-perennial	0%	4%	16%	16%	
	MSh-U:TE	tree-encroached	0%	5%	8%	7%	
Elko	MSh-A:AL	early	7%	40%	14%	8%	1%
	MSh-B:CL	mid-open	24%	3%	10%	5%	5%
	MSh-C:CL	mid-closed	39%	0%	23%	29%	37%
	MSh-D:OP	late-open	30%	39%	22%	26%	0%
	MSh-U:DP	depleted	0%	0%	1%	2%	27%
	MSh-U:ES	early shrub	0%	1%	8%	5%	25%
	MSh-U:SAP	shrub-annual-perennial	0%	1%	5%	4%	4%
	MSh-U:TE	tree-encroached	0%	16%	17%	21%	0%
Mojave	MSh-A:AL	early	7%	0%	0%	0%	2%
	MSh-B:CL	mid-open	23%	0%	0%	0%	10%
	MSh-C:CL	mid-closed	41%	14%	0%	0%	62%
	MSh-D:OP	late-open	29%	0%	0%	0%	6%
	MSh-U:DP	depleted	0%	1%	4%	6%	4%
	MSh-U:ES	early shrub	0%	0%	37%	24%	4%
	MSh-U:SAP	shrub-annual-perennial	0%	0%	1%	1%	6%
	MSh-U:TE	tree-encroached	0%	85%	58%	69%	6%
Owyhee	MSh-A:AL	early	7%	41%	8%	0%	
	MSh-B:CL	mid-open	24%	44%	12%	8%	
	MSh-C:CL	mid-closed	39%	4%	68%	92%	
	MSh-D:OP	late-open	30%	0%	4%	0%	
	MSh-U:DP	depleted	0%	9%	0%	0%	
	MSh-U:ES	early shrub	0%	0%	0%	0%	
	MSh-U:SAP	shrub-annual-perennial	0%	1%	8%	0%	
	MSh-U:TE	tree-encroached	0%	0%	0%	0%	

➢ ***Intermountain Coniferous Forests & Woodlands***

Table C.20. Predicted Change In Acreage of Mixed Conifer With 50 Years of Climate Change.

Region	***Current Acres***	***Projected Acres w CC***	***Net Change***	***Percent change***
Black Rock	7424	7470	288	4%
Calcareous	109655	111616	2736	3%
Elko	37235	36740	5274	17%
Mojave	22261	22308	-918	-4%

Table C.21. Vegetative Class Percentages for Mixed Conifer in Four Primary Regions.

Region	*Class*	*Description*	*reference*	*Initial*	*No CC*	*CC no Mgmt*	*CC w Mgmt*
Black Rock	MC-A:AL	early	22%	21%	25%	20%	
	MC-B:CL	mid-closed	21%	20%	19%	39%	
	MC-C:OP	mid-open	13%	55%	18%	3%	
	MC-D:OP	late-open	28%	1%	27%	6%	
	MC-E:CL	late-closed	16%	3%	10%	31%	
	MC-U:AG	annual grass	0%	0%	0%	0%	
	MC-U:TA	tree-annual grass	0%	0%	0%	1%	
Calcareous	MC-A:AL	early	23%	11%	25%	20%	41%
	MC-B:CL	mid-closed	21%	74%	26%	27%	30%
	MC-C:OP	mid-open	14%	15%	16%	9%	2%
	MC-D:OP	late-open	28%	0%	22%	16%	9%
	MC-E:CL	late-closed	14%	0%	10%	28%	18%
	MC-U:AG	annual grass	0%	0%	0%	0%	0%
	MC-U:TA	tree-annual grass	0%	0%	0%	0%	0%
Elko	MC-A:AL	early	22%	1%	12%	13%	40%
	MC-B:CL	mid-closed	21%	0%	3%	4%	0%
	MC-C:OP	mid-open	13%	0%	0%	0%	0%
	MC-D:OP	late-open	28%	0%	11%	3%	0%
	MC-E:CL	late-closed	16%	0%	6%	20%	0%
	MC-U:AG	annual grass	0%	0%	34%	8%	0%
	MC-U:TA	tree-annual grass	0%	99%	33%	52%	0%
Mojave	MC-A:AL	early	18%	22%	22%	15%	20%
	MC-B:CL	mid-closed	16%	3%	15%	24%	23%
	MC-C:OP	mid-open	11%	1%	11%	5%	7%
	MC-D:OP	late-open	30%	15%	35%	16%	24%
	MC-E:CL	late-closed	25%	60%	16%	39%	24%
	MC-U:AG	annual grass	0%	0%	0%	0%	0%
	MC-U:TA	tree-annual grass	0%	0%	0%	1%	0%

Table C.22. Predicted Change In Acreage of Limber Pine/Bristlecone Pine With 50 Years of Climate Change.

Region	*Current Acres*	*Projected Acres w CC*	*Net Change*	*Percent change*
Black Rock	1989	1995	6	0%
Calcareous	45295	47966	2670	6%
E Sierra	6480	6424	-57	-1%
Elko	29255	33918	4664	16%
Eureka	1418	1345	-73	-5%
Mojave	12830	12545	-285	-2%
Toiyabe	34841	34187	-653	-2%

Table C.23. Vegetative Class Percentages for Limber Pine/Bristlecone Pine.

Region	Class	Description	Reference	Initial	No CC	CC no mgmt
Black Rock	LB-A:AL	early	10%	55%	28%	27%
	LB-B:OP	mid-open	12%	18%	43%	43%
	LB-C:OP	late-open	78%	27%	29%	30%
Calcareous	LB-A:AL	early	10%	19%	17%	11%
	LB-B:OP	mid-open	13%	22%	24%	28%
	LB-C:OP	late-open	77%	59%	59%	61%
E Sierra	LB-A:AL	early	10%	27%	21%	18%
	LB-B:OP	mid-open	13%	47%	41%	44%
	LB-C:OP	late-open	77%	25%	38%	39%
Elko	LB-A:AL	early	10%	47%	34%	27%
	LB-B:OP	mid-open	12%	52%	52%	60%
	LB-C:OP	late-open	78%	1%	14%	12%
Eureka	LB-A:AL	early	10%	21%	15%	12%
	LB-B:OP	mid-open	13%	39%	33%	33%
	LB-C:OP	late-open	77%	40%	52%	55%
Humboldt	LB-A:AL	early	10%	50%	10%	30%
	LB-B:OP	mid-open	13%	31%	60%	50%
	LB-C:OP	late-open	77%	19%	30%	20%
Lahontan	LB-A:AL	early	10%	72%	60%	47%
	LB-B:OP	mid-open	13%	27%	33%	47%
	LB-C:OP	late-open	77%	1%	7%	7%
Mojave	LB-A:AL	early	10%	0%	4%	3%
	LB-B:OP	mid-open	12%	12%	9%	9%
	LB-C:OP	late-open	78%	88%	88%	89%
Toiyabe	LB-A:AL	early	10%	21%	14%	13%
	LB-B:OP	mid-open	13%	30%	30%	28%
	LB-C:OP	late-open	77%	49%	57%	59%
Tonopah	LB-A:AL	early	10%	26%	25%	5%
	LB-B:OP	mid-open	13%	38%	25%	40%
	LB-C:OP	late-open	77%	36%	50%	55%
Walker	LB-A:AL	early	10%	100%	0%	0%
	LB-B:OP	mid-open	13%	0%	0%	0%
	LB-C:OP	late-open	77%	0%	0%	0%

Table C.24. Vegetative Class Percentages for Ponderosa Pine.

Region	Class	Description	Reference	Initial	No CC	CC no Mgmt	CC w Mgmt
Calcareous	PP-A:AL	early	11%	17%	3%	45%	0%
	PP-B:CL	mid-closed	2%	47%	8%	10%	0%
	PP-C:OP	mid-open	34%	12%	35%	15%	0%

	PP-D:OP	late-open	52%	3%	17%	10%	0%
	PP-E:CL	late-closed	1%	22%	4%	0%	0%
	PP-U:AG	annual grass	0%	0%	17%	0%	0%
	PP-U:TA	tree-annual grass	0%	0%	17%	20%	0%
Clover	PP-A:AL	early	11%	6%	7%	0%	
	PP-B:CL	mid-closed	2%	25%	1%	7%	
	PP-C:OP	mid-open	34%	54%	39%	30%	
	PP-D:OP	late-open	52%	1%	26%	27%	
	PP-E:CL	late-closed	1%	3%	1%	6%	
	PP-U:AG	annual grass	0%	0%	12%	1%	
	PP-U:TA	tree-annual grass	0%	11%	15%	29%	
Mojave	PP-A:AL	early	11%	6%	3%	2%	3%
	PP-B:CL	mid-closed	3%	2%	1%	3%	1%
	PP-C:OP	mid-open	33%	1%	14%	12%	19%
	PP-D:OP	late-open	52%	21%	60%	46%	43%
	PP-E:CL	late-closed	1%	69%	5%	20%	18%
	PP-U:AG	annual grass	0%	0%	3%	0%	0%
	PP-U:TA	tree-annual grass	0%	0%	14%	17%	16%

Table C.25. Predicted Change In Acreage of Ponderosa Pine With 50 Years of Climate Change.

Region	*Current Acreage*	*Projected Acreage*	*Net Change*	*Percent Change*
Calcareous	547	101	-446	-82%
Clover	5519	6040	521	9%
Mojave	24557	26189	1632	7%

Table C.26. Vegetative Class Percentages for Spruce-Fir.

Region	*Class*	*Description*	*Reference*	*Initial*	*No CC*	*CC no Mgmt*	*CC w Mgmt*
Black Rock	SF-A:AL	early	18%	82%	27%	7%	
	SF-B:CL	mid1-closed	38%	0%	47%	65%	
	SF-C:OP	mid1-open	2%	11%	16%	10%	
	SF-D:CL	late-closed	42%	7%	9%	18%	
Calcareous	SF-A:AL	early	18%	8%	25%	13%	37%
	SF-B:CL	mid1-closed	38%	20%	33%	42%	56%
	SF-C:OP	mid1-open	2%	42%	11%	5%	7%
	SF-D:CL	late-closed	42%	30%	32%	40%	0%
Elko	SF-A:AL	early	18%	28%	27%	10%	0%
	SF-B:CL	mid1-closed	38%	31%	41%	53%	20%
	SF-C:OP	mid1-open	2%	41%	14%	13%	0%
	SF-D:CL	late-closed	42%	0%	18%	24%	0%

Table C.27. Predicted Change in Spruce-Fir with 50 Years of Climate Change.

Region	*Current Acres*	*Projected Acres W CC*	*Net Change*	*Percent Change*
Black Rock	869	928	59	7%
Calcareous	22077	24530	2453	11%
Elko	43829	47794	3966	9%

➢ ***Warm Desert Riparian***

Table C.28. Vegetative Classes for Warm Desert Riparian.

Region	*Class*	*Description*	*Reference*	*Initial*	*No CC*	*CC no mgmt*
Clover	WDR-A:AL	early	9%	41%	30%	40%
	WDR-B:CL	mid-closed	16%	59%	25%	30%
	WDR-C:OP	mid-open	16%	0%	0%	0%
	WDR-D:CL	late1-closed	35%	0%	0%	5%
	WDR-E:CL	late2-closed	24%	0%	10%	0%
	WDR-U:DE	desertification	0%	0%	0%	0%
	WDR-U:DEF	desertified-exotic forb	0%	0%	0%	0%
	WDR-U:DET	desertified-exotic tree	0%	0%	0%	0%
	WDR-U:EF	exotic-forb	0%	0%	5%	10%
	WDR-U:ET	exotic-tree	0%	0%	30%	15%
Mojave	WDR-A:AL	early	9%	59%	0%	0%
	WDR-B:CL	mid-closed	16%	25%	0%	0%
	WDR-C:OP	mid-open	16%	3%	0%	0%
	WDR-D:CL	late1-closed	35%	2%	0%	0%
	WDR-E:CL	late2-closed	24%	0%	0%	0%
	WDR-U:DE	desertification	0%	1%	46%	50%
	WDR-U:DEF	desertified-exotic forb	0%	0%	17%	17%
	WDR-U:DET	desertified-exotic tree	0%	4%	20%	21%
	WDR-U:EF	exotic-forb	0%	0%	7%	4%
	WDR-U:ET	exotic-tree	0%	4%	10%	8%
Tonopah	WDR-A:AL	early	9%	84%	0%	0%
	WDR-B:CL	mid-closed	16%	16%	0%	0%
	WDR-C:OP	mid-open	16%	0%	0%	0%
	WDR-D:CL	late1-closed	35%	0%	0%	0%
	WDR-E:CL	late2-closed	24%	0%	0%	0%
	WDR-U:DE	desertification	0%	0%	50%	62%
	WDR-U:DEF	desertified-exotic forb	0%	0%	16%	10%
	WDR-U:DET	desertified-exotic tree	0%	0%	17%	12%
	WDR-U:EF	exotic-forb	0%	0%	9%	6%
	WDR-U:ET	exotic-tree	0%	0%	8%	9%

➢ ***Alpine Tundra***

Table C.29. Vegetative Classes for Alpine Tundra.

Region	*Class*	*Description*	*Reference*	*Initial*	*No CC*	*CC no mgt*
E. Sierra	ALP-A:AL	early	1%	0%	0%	0%
	ALP-B:CL	late-closed	99%	100%	100%	100%
Elko	ALP-A:AL	early	1%	60%	13%	10%
	ALP-B:CL	late-closed	99%	40%	87%	90%

Table C.30. Vegetative Classes for Semi-desert Grassland.

Region	*Class*	*Description*	*reference*	*Initial*	*No CC*	*CC No Mgt*
Black Rock	SG-A:OP	early	18%	0%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	2%	1%	1%
	SG-U:ES	early shrub	0%	0%	0%	0%
	SG-U:SAP	shrub-annual-perennial	0%	98%	99%	99%
Calcareous	SG-A:OP	early	18%	9%	2%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	18%	14%	12%
	SG-U:ES	early shrub	0%	0%	12%	15%
	SG-U:SAP	shrub-annual-perennial	0%	72%	73%	73%
Clover	SG-A:OP	early	18%	12%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	39%	33%	37%
	SG-U:ES	early shrub	0%	0%	13%	10%
	SG-U:SAP	shrub-annual-perennial	0%	49%	53%	53%
Elko	SG-A:OP	early	18%	0%	0%	0%
	SG-B:OP	mid-closed	82%	5%	1%	1%
	SG-U:DP	depleted	0%	0%	2%	3%
	SG-U:ES	early shrub	0%	95%	97%	96%
	SG-U:SAP	shrub-annual-perennial	0%	0%	0%	0%
Eureka	SG-A:OP	early	18%	5%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	10%	8%	9%
	SG-U:ES	early shrub	0%	0%	7%	6%
	SG-U:SAP	shrub-annual-perennial	0%	84%	85%	85%
Humboldt	SG-A:OP	early	18%	0%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	0%	0%	0%
	SG-U:ES	early shrub	0%	1%	1%	1%
	SG-U:SAP	shrub-annual-perennial	0%	99%	99%	99%

Lahontan	SG-A:OP	early	18%	4%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	28%	21%	24%
	SG-U:ES	early shrub	0%	0%	9%	8%
	SG-U:SAP	shrub-annual-perennial	0%	68%	70%	67%
Mojave	SG-A:OP	early	18%	29%	0%	0%
	SG-B:OP	mid-closed	82%	22%	0%	4%
	SG-U:DP	depleted	0%	21%	24%	20%
	SG-U:ES	early shrub	0%	0%	32%	24%
	SG-U:SAP	shrub-annual-perennial	0%	29%	44%	52%
Owyhee	SG-A:OP	early	18%	7%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	1%	0%	0%
	SG-U:ES	early shrub	0%	0%	0%	0%
	SG-U:SAP	shrub-annual-perennial	0%	93%	100%	100%
Toiyabe	SG-A:OP	early	18%	5%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	3%	1%	2%
	SG-U:ES	early shrub	0%	0%	6%	5%
	SG-U:SAP	shrub-annual-perennial	0%	92%	93%	93%
Tonopah	SG-A:OP	early	18%	50%	6%	6%
	SG-B:OP	mid-closed	82%	0%	24%	34%
	SG-U:DP	depleted	0%	35%	24%	24%
	SG-U:ES	early shrub	0%	0%	23%	6%
	SG-U:SAP	shrub-annual-perennial	0%	15%	23%	30%
Walker	SG-A:OP	early	18%	2%	0%	0%
	SG-B:OP	mid-closed	82%	0%	0%	0%
	SG-U:DP	depleted	0%	2%	0%	0%
	SG-U:ES	early shrub	0%	0%	0%	0%
	SG-U:SAP	shrub-annual-perennial	0%	96%	100%	100%

Additional Information on Prescriptive Actions

Lower Montane Woodlands and Chaparral

Mojave

Prescribed burning and native seeding was applied in the tree-encroached shrubland at a rate of 11,800 acres per year for five years at a cost of $150 per acre. Without treatment, the mountain shrub type was projected to essentially “vanish” from the Mojave landscape as it transitioned to the Chaparral BpS. The treatment produced better results. Although the BpS shrunk, but not entirely, ecological departure was much improved with 80 percent of the BpS restored to characteristic classes and only 20 percent left in uncharacteristic classes.

Calcareous

Two treatments were applied in the Calcareous region – prescribed burning in the "mid-closed" class and herbicide to control annuals in the "shrub annual perennial grass" class. The burning treatment was applied to 150 acres per year over fifty50 years at a cost of $50 per acre, while the herbicide treatment was applied to 40 acres per year over 50 years at a cost of $100 per acre. The result was a decrease in the overstocked "mid-closed" class, more percentage in the two youngest types, and a better distribution over all characteristic classes more closely approximating reference conditions. Percentages in uncharacteristic classes were maintained at levels very similar to current conditions, but the percent transition predicted after 50 years of climate change was reduced by 40 percent. Loss of the mountain shrub BpS to sagebrush conversion was slightly elevated (2,800 acres, 22 percent lost) from the same loss projected for 50 years of climate change without treatment (2,500 acres, 20 percent lost), but the gain in ecological health of the type was expected to improve it as mule deer summer range as a mitigating element. Monitoring of mule deer population response to the changes would be required to quantify the net result.

Elko

In the Elko region, prescribed burning was applied in the two older characteristic classes (Cmid-closed and late-open) in order to redistribute stands among characteristic classes. Annual grass invasion was ignored. The prescription was applied to 500 acres per year over the first 1010 years at a cost of $50 per acre, the least expensive application of the three regions. Results were less than satisfactory – while the Dlate-open class was transitioned back to Cmid-closed class, the current "early" class was transitioned largely to "depleted" and "early shrub" (rabbitbrush) classes, where apparently the "tree-encroached" class was also largely transitioned. An increase of 38 percent in uncharacteristic classes from current conditions resulted, including a 24 percent increase in "early shrub", a class deemed unsuitable for priority wildlife. Fifty years of climate change without treatment would have resulted in a better distribution across characteristic classes and only a 14 percent increase in uncharacteristic classes, including only a four percent increase in the "early shrub" class. One positive outcome of treatment was that loss of the BpS to sagebrush conversion was reduced from 18 percent with climate change and no management to 12 percent with management. That most if not all of that six percent salvaged was "parked" in "early shrub" would require an evaluation of the feasibility of restoring the rabbitbrush expression back to functional mountain brush habitat post-2062 to determine if net ecological gain was achieved. Otherwise, the prescription seems risky at best.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Mojave			
• Prescribed burning and native seeding in tree-encroached shrubland (TE)	11,789	1st 5	150
Calcareous			
• Prescribed burning in third oldest reference class (C)	150	50	50
• Herbicide to control annuals in Shrub-Annual-Grass-Perennial-Grass class (SAP)	40	50	100

Elko			
• Prescribed burning in two older reference classes (C and D)	500	1st 10	50

Mojave Warm Desert and Mixed Desert Scrub

Thermic and Mesic Blackbrush

The herbicide is 40-60 percent successful, but success changes from the first to the second year after application (Dr. Leslie DeFalco, USGS Henderson, NV, personal communication, 2011); therefore, we chose a 50 percent success rate. Herbicide alone was applied to the Shrub-Annual-Grass-Perennial-Grass class to recover late-succession blackbrush. Recovery of the Annual Grass class is the greatest challenge because the success rate of native seedlings is currently very low (one percent). Mojave ecosystem scientists are currently very active in the research of developing new plant material and species combinations with better restoration success rates (Abella et al., 2010); therefore "hypothetical" restoration treatments were proposed that assumed continuation of the current level of success (one percent) for the first 20 years, then, following a 20-year period of research, a 10 percent success rate for the remaining 30 years of the simulation. The newer success rate was dependent on one important assumption that made a great difference: livestock grazing had to be deferred in the new seeded areas, otherwise the seeding failed because of herbivory on young plants. The average annual cost of these treatments was, respectively, $1,530,943 and $1,228,790 for a total of $76,547,162 in mesic blackbrush and $61,439,475 in thermic blackbrush over 50 years.

Management actions reduced ED by 40 percent in mesic blackbrush and by 11 percent in thermic blackbrush. Reduction of ED in thermic blackbrush was more difficult than in mesic blackbrush because succession is much slower at the lower elevations in thermic blackbrush.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
• Spray herbicide to control exotic annuals in blackbrush with an understory of exotic annuals	15,000	50	25
• Spray herbicide to control exotic annuals and seed native species (current seed mix) in annual grassland	10,000	1st 20	100
• Spray herbicide to control exotic annuals and seed native species (new seed mix) in annual grassland	15,000	last 30	150
• Retire livestock grazing in areas seeded with native seed		50	

Creosote Bush-White Bursage

This BpS is more extensive than blackbrush; therefore, implementation rates were also more extensive. The 50-year outcome resulted in ED being reduced by 32 percent for creosote bush-white bursage. The average annual cost of these treatments was $1,535,558 for a total of $76,777,892 in creosote bush-white bursage over the 50 year period.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
• Spray herbicide to control exotic annuals in blackbrush with an understory of exotic annuals	37,000	50	25
• Spray herbicide to control exotic annuals and seed native species (current seed mix) in annual grassland	5,500	1st 20	100
• Spray herbicide to control exotic annuals and seed native species (new seed mix) in annual grassland	37,000	last 30	150
• Retire livestock grazing in areas seeded with native seed		50	

Sagebrush

Big Sagebrush Upland

The following text comes directly from the TNC Report:

> *The Big Sagebrush-upland BpS represents most people's idea of the traditional mountain big sagebrush communities; however, this BpS also includes the upland soils of Wyoming big sagebrush communities and their hybrid zone. The BpS is fairly productive, but experiences high levels of invasion of cheatgrass and encroachment of pinyon and juniper into open shrublands. Moreover, decades of management have homogenized the BpS towards late-succession class dominance and past livestock practices have often depleted the understory of its herbaceous layer. Although the BpS probably deserves restoration in all regions of Nevada, the added effect of climate change was only detected in the Walker region where late-succession classes with pinyon-juniper were over-represented. Mechanical methods of tree removal were simulated as partners expressed local agency resistance to the use of prescribed fire.*

The average annual cost of this treatment in big sagebrush-upland in the Walker region was ~$196,800 for a total of ~$9,838,200 over 50 years. Mastication of trees reduced ecological departure by 16 percent and high risk classes by 14 percent. Mastication caused the early and mid-succession classes to increase and prevented the late-succession class from converting to the tree-encroached class.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Walker			
• Mastication of late-succession class (E)	275	50	700

Low/Black Sagebrush

Low and black sagebrush are found on harsh soils with shallow root restricting layers. Cheatgrass invasion is usually low to moderate. Pinyon and juniper invasion also occurs slowly, although more rapidly and completely in black sagebrush communities. Given the importance of both low and black sagebrush to Greater Sage-grouse diet and the intolerance of grouse for trees, restoration was focused on tree removal in the Tree-Encroached class (TNC Report).

The average annual cost of the treatment of low/black sagebrush in the Calcareous region was ~$1,208,000 for a total of ~$60,403,700 over 50 years. The tree-encroached class was reduced 11 percent from its predicted level with 50 years of climate change (Appendix G). Other wildlife-unsuitable classes were hardly affected if at all. This seemed a very costly application of resources for such minimal positive result.

In the Walker region, average annual cost was ~$55,300 for a total of ~$2,769,700 over 50 years. The distribution between characteristic classes was improved considerably over current conditions, but not so much over what was predicted to result with 50 years of climate change (Appendix G). Reductions in wildlife-unsuitable classes were more successful – the early shrub (rabbitbrush) class was reduced 15 percentage points from what was predicted to occur with 50 years of climate change. Tree-invaded classes were reduced 10 percentage points from the 50-year climate change prediction. These results coupled with the noticeably more economical price tag of the Walker prescription suggested better cost-return for the conservation action in the Walker region when compared to the Calcareous region.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Calcareous			
• Chaining and native seeding in Tree-Encroached class	9,300	50	130
• Mastication and native seeding in Tree-Encroached class	1,000	50	350
Walker			
• Chainsaw-lop and seed in Tree-Annual-Grass and Tree-Encroached classes	1,000	50	350

Montane Sagebrush Steppe Mountain

This vegetation community is relatively cost-effective to treat because of its built-in resiliency facilitated by a 14-inch precipitation regime, healthy seed sources, and the general absence of cheatgrass. The management action most often applied is prescribed fire. The average annual cost of treatment in the Calcareous region was ~$222,300 for a total of ~$11,113,000 over 50 years. In the Lahontan region, average annual cost ran ~$330,100 for a total of ~$16,503,600 over 50 years.

In the Calcareous region, prescribed burning redistributed acreage between the three early and mid-successional stages to more closely approximate reference conditions, reduced the percentages of depleted class and early shrub (rabbitbrush) each five percent lower than climate change with no management, but produced little or no significant change in the percentages of annual grass or tree-encroached). Wildlife habitat improvement occurred in some reduction of rabbitbrush-domination, and could also be inferred through the general concept of ecosystem health. Thirteen percent of the type in the early class in 50 years would be temporarily unsuitable to many sagebrush birds and mammals for the next 12 to 15 years, but as explained previously, on a good track for vegetative recovery

In the Lahontan region, treatment produced little effect on the distribution of acres among all classes from what would occur with climate change and no management. Percentages in the early shrub class were reduced five percent but the annual grass class increased five percent for no net effect. These results indicated that a strong case for treatment to improve wildlife habitat could not be made in this region without addressing the source and incidence of annual grass invasion.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Calcareous			
• Prescribed burning in the three oldest succession classes (C, D, and E)	8,800	50	25
Lahontan			
• Prescribed burning in the three oldest succession classes (C, D, and E)	3,000	50	110

Wyoming Big Sage

From the TNC Report:

> *The Wyoming Big Sagebrush BpS is difficult to restore because the success of any seeding is low at semi-desert elevations (about 50 percent successful without livestock grazing), unless introduced crop species such as crested wheatgrass are used. During simulations with partners, it became clear that large areas of this BpS are very expensive to restore and restoration would accomplish meager ecological returns. The two regions where management simulations were conducted reflect very different approaches to restoration. The Calcareous region is mostly dominated by black sagebrush communities with Wyoming big sagebrush communities found in shallow valleys or at the toe of non-carbonate mountain ranges; therefore, management in semi-desert Wyoming big sagebrush is often conducted for small wildlife projects where the primary goal is to remove trees. In contrast, the Wyoming Big Sagebrush BpS is the dominant matrix community in the Elko region; therefore, restoration is at large scale.*

The average annual cost of Wyoming big sagebrush treatment in the Calcareous region was ~$22,000 for a total of ~$1,101,900 over 50 years. As a result of the treatment, the model predicted that annual grass and shrub-annual grass increased because of the failure rate of re-seeding, thus rendering this treatment suspect for improving or maintaining long term wildlife-suitable habitat; however, removal of trees achieved it's short term goal..

The average annual cost of Wyoming big sagebrush treatment in the Elko region was ~$154,100 for a total of ~$7,705,200 over 50 years. The treatment essentially shifted half the acres from the shrub-annual grass class to annual grass and tree-annual grass classes – both decidedly inferior to the already impacted shrub-annual grass class with respect to wildlife habitat suitability, thus this expenditure of resources did not seem particularly fruitful.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Calcareous			
• Chainsaw lopping of pinyon and juniper in the tree-encroached and cheatgrass invaded class (TA) for wildlife value	450	50	50

Elko			
• Mechanically thin dense sagebrush cover, spray herbicide to control cheatgrass, and seed native species in the Shrub-Annual-Grass class	3,000	1st 20	130

Sierra Coniferous Forests and Woodlands

A multi-tiered prescription was developed for Jeffrey pine involving prescribed burning, mastication of young conifers, prescriptive sheep grazing in annual grass classes, pre-commercial thinning of young conifers, and commercial thinning of mid-succession closed stands. For mixed conifer, treatment was limited to thinning, pile burning, and prescribed burning in closed classes. An annual cost of $272,000 for the Jeffrey pine prescription projected out to $13.5 million spent over 50 years, while the mixed conifer prescription cost $16,700 per year for a total of $836,000 over 50 years. Despite the amount of money spent reducing closed-canopy classes, conditions improved only very slightly in both BpS's (four percent decrease in ecological departure). The prescriptive grazing did have a positive impact in the annual-grass-invaded classes of Jeffrey pine, decreasing them by 13 percent after 50 years. This reduction was probably most valuable in providing a somewhat reciprocal increase in fire management options and capability. The main reason for these small gains is that the area treated is small due to severe regulatory limitations placed on the use of mechanical methods and access to areas needing restoration.

The Northern Sierra Report recommended applying prescribed fire to dry lodgepole pine stands to prevent predominant late-open classes from progressing on toward late-closed and redistribute stands more heavily in early and mid-successional stages. The report predicted that an intensive prescribed burning program (called "maximum management" in the report) applied in the first 20 years would effectively return the dry lodgepole BpS to reference conditions and a natural resiliency that might preclude further treatment over the last 30 years. The average annual cost for the most effective treatment (maximum management) was $6.60 per acre, so if 290 acres of the dry lodgepole pine type exists in Nevada (TNC 2011), the average annual cost would be approximately $1900 for a total cost of $38,000 over the 20-year treatment period. On the other hand, if there really are less than 300 acres of this type existing in Nevada, an evaluation of the priority need to act as well as the predicted responses of wildlife to the treatment would be in order as the need to treat at such a small scale without specific high-priority wildlife objectives might not be sufficient to warrant the effort and expense.

Strategy	Rate (acres/yr)	Years of Application	Cost ($/acre)
Jeffrey Pine			
• Prescribed burning in mid-succession closed class (B)	30	50	650
• Masticate young conifers in early succession class (A)	50	50	300
• Prescriptive livestock (mostly sheep) grazing in Annual Grassland and Tree-Annual-Grass classes (AG and TA)	1000	50	10
• Pre-commercial thinning of young conifers in early succession class (A)	250	50	750
• Commercial thinning of mid-succession closed class (B)	55	50	750
Mixed Conifer			
• Thinning, pile burning, and prescribed burning in closed classes (B and E)	10	50	2000

APPENDIX D

IDENTIFICATION OF SPECIES OF CONSERVATION PRIORITY: DETAILED METHODS AND APPROACH

2005 Wildlife Action Plan: Terrestrial Nongame Birds, Mammals, and Reptiles

Methods

The Species of Conservation Priority identification process began in July, 2002. After initially gathering input from partner land management agency personnel at the field level, a Species Priority Matrix was developed using standard species conservation prioritization methodology (Natural Heritage Scorecard; Panjabi et al. 2001). Nevada Natural Heritage Program Species Scorecard scores were incorporated into the Species Priority Matrix. NDOW Wildlife Diversity biologists were subsequently asked to score all species of nongame birds, mammals, and reptiles using the Species Priority Matrix. The Species Priority Matrix contained the following scoring categories.

1. *Endangered, Threatened, or Candidate Species*

Species with Endangered, Threatened, or Candidate Species status under either federal or state law were given 1 point. Total points possible in this category was 1 – multiple points for having both federal and state status were not given because state statutes are designed to generally reflect federal status.

2. *Nevada Natural Heritage Program Score – Inverted*

Each species was given the inverted score of the Nevada Natural Heritage Program State Rank score; that is, NNHP scores run from 1 (highest risk) to 5 (lowest risk), so it was necessary to invert the score in order for "highest risk" to have the greatest arithmetic weight in the matrix. The conversion scale is illustrated in the following table.

NNHP State Rank	NV Species Priority Matrix Score
5	1
4	2
3	3
2	4
1	5

3. *Threat*

The biologists were asked to assign scores to each species representing their perception of the degree of threat facing the species. The degree of threat was comprehensively assessed taking into account all possible threats and their degree of severity. This comprehensive approach basically followed that of the Partners In Flight

Species Assessment Database, and the following score criteria were adapted from the PIF exercise.

1. Future conditions (habitat quantity, habitat quality, disturbance, disease, predation, parasitism, competition with exotics, human exploitation, contaminants, etc.) are expected to remain stable; no known threats

2. Future conditions are expected to experience a slight decline; sustainable with little or no remedial action taken

3. Future conditions are expected to experience a moderate decline; correctable with moderate remedial action taken

4. Future conditions are expected to experience severe deterioration; not easily correctable without significant remedial action taken.

5. Future conditions are expected to experience extreme deterioration; immediate emergency action required; species is in danger of regional extirpation or major range contraction.

After threat scores were collected from all the Wildlife Diversity biologists, a rather complicated method of vote evaluation was implemented to derive a single threat score out of seven. Any score that received a clear majority out of seven was retained. Where two scores tied for a majority, the higher score was selected. Where three consecutive scores tied for a majority (that is, a 2, 3, and 4 for instance), the middle score (in this instance, 3) was retained.

4. Area Importance

This column evaluates Nevada's *area responsibility* for the maintenance of the continental population of a species. A three-tier score was assigned (1 – low responsibility; 2 – moderate responsibility; 3 – high responsibility). The scoring was heavily dependent on the color status maps available on the NatureServe website (2002) and (for birds), the PIF Species Assessment database. Evaluation was subjective -- based on the percent of range Nevada represented in a species' total continental range with consideration for the relationship of degree of concern in Nevada compared to surrounding states.

5. Current Knowledge

Wildlife Diversity biologists face an overwhelming task of building a knowledge base and management tool kit for hundreds of species – many of which are rarely encountered, much less understood. Critical questions include, *What do we know about this species? Could we design an effective conservation strategy based on what we know now? What information is missing that would prevent us from demonstrating improvement in the management of this species?*

State nongame programs have relatively similar histories regarding program species emphasis over the past thirty years. Most states have built strong bird conservation programs – particularly raptors, wetland birds, and songbirds. Reptiles and small mammals, on the other hand, have not received the historical program emphasis except as driven by political forces – particularly species listing concerns. Program expansion as facilitated by SWG produces a natural expectation that diversity programs will direct their emphases into areas where knowledge is lacking. Scores in this column were divided into three values – 3 representing species for which relatively little scientific knowledge was available; 2 representing a moderate level of knowledge; 1 representing species already benefiting from long-term historical study and accumulation of knowledge.

6. Opportunity

The Opportunity column evaluates the degree of opportunity the Bureau has to 1) Learn something significant about a species, and 2) implement a conservation strategy that has a discernible chance of making a significant positive difference in the management of a species. This is in effect a "cost-benefit ratio" criterion, acknowledging that not all species are equal when it comes to our ability to construct significant management strategies for them. This analysis is appropriate to this exercise because the Species of Conservation Priority process was conceived as a "program emphasis" exercise – not exclusively a "species at risk" evaluation. To recognize opportunity as an evaluative criterion is to recognize the value of the groundwork that has been laid prior to SWG and keep the Wildlife Diversity program on course to realize the products of both prior scientific program development and conservation partnership-building. Scores were divided again into three values – with 1 representing relatively low opportunity and 3 representing relatively high opportunity. Generally speaking, species with low detection rates that would require intensively focused efforts to research (like most snakes) scored 1; species with high partner interest and processes in place to pool resources and share deliverables (like land birds and water birds – with collaborative monitoring and conservation delivery efforts already underway) scored 3; species with moderate to high partner interest but certain life history elements that might require some specialized, possibly difficult effort scored 2.

Results

Score

The simple addition of the values from the six categories produced a score that could range from 5 (score 1 in five categories and 0 in T/E/C) to 20 (maximum scores in all categories). Computed scores ranged from 6 to 17 (banded Gila monster). Distribution of the scores was fairly normal (high around the mean and tailed off at either extreme), and it was determined that about 20 percent of all species scored 13 or higher. Further analysis of potential cutoff scores indicated that 13 and above would provide fairly comprehensive habitat and taxonomic group coverage, while 14 and above would have potentially left some habitat and taxonomic coverages rather thin. Many migratory bird species with irregular or insignificant presence in the state (species for which we would not likely develop management strategies) were not scored.

Initially, exactly 100 species scored 13 or above. A secondary analysis was performed on species below the cutoff threshold (13) to see if there were species for which the math of the matrix did not provide adequate or accurate representation. An additional list of 19 species were found to warrant program emphasis despite their matrix scores. Those species were elevated to the Priority List with rationale raising the species total on the Priority List to 119.

Expert review

At the computation of the draft list, NDOW circulated the matrix results to 26 agency and conservation partners for review. Responses were received back from the U.S. Fish and Wildlife Service – Region I Office, Portland, USFWS, Univ. Nevada, Reno – Department of Environmental and Resource Sciences, Nevada Natural Heritage Program, and USFS Humboldt-Toiyabe National Forest. All reviewers who responded commented on the basic soundness of the approach. Most comments received pertained to format and style matters (addition of scientific names, consistency details in some of the non-scoring columns, etc.).

List review and adjustments

The Species of Conservation Priority list was reviewed by the Wildlife Diversity biologists' team in December, 2004. Several species omitted from the 2002 priority selection were submitted for reconsideration. Matrix scores for the species of reconsideration were revisited, new scores were generated by consensus, and adjustments were made to the Species of Conservation Priority list based on the results. The Wildlife Diversity team also expressed concern about the integration of the Nevada species prioritization process with existing species planning efforts, most notably the various bird conservation initiatives and their continental and regional conservation plans. The publication of the Partners In Flight North American Landbird Conservation Plan in February, 2004 with its new Watch List and Bird Conservation Region priority lists made a re-evaluation of the Nevada process seem particularly pertinent.

An evaluation of Bird Plan priorities was integrated into the Nevada Species Priority Matrix. Bird species were given scores based on their relative priority within their respective continental and regional bird conservation plans. The six bird conservation plans included in the analysis included:

Partners In Flight North American Bird Conservation Plan
U.S. Shorebird Conservation Plan
North American Water Bird Conservation Plan
Nevada Partners In Flight Bird Conservation Plan
Intermountain West Report to the U.S. Shorebird Conservation Plan
Intermountain West Water Bird Conservation Plan

Two columns were added to the Species Priority Matrix – Continental Bird Plan Score and Regional Bird Plan Score. Scores ranging from 1-3 were assigned each species mentioned in any plan as a priority species, with 1 representing lowest elevated priority, 2 representing medium priority, and 3 representing highest priority within a plan. The Nevada PIF Bird Conservation Plan did not rank species in priority tiers, so species in the Nevada PIF plan only received a 1 (in the plan). After all plan priority species were scored, a third column was added to the Matrix and the higher of the two Bird Plan scores was entered into it, representing the species final Bird Plan score for addition to the total score. The final ranking of bird species following this conservation plan priority analysis produced a top-to-bottom array more representative of local, regional, and continental concerns.

Stewardship species

There was still a problem with the bird species list, however. After initially deciding that all plan priority birds would be included on the Nevada Species of Conservation Priority list, it was discovered that the total list of plan priority birds expanded the bird list to 115 species – almost the sum total of the entire list including mammals and reptiles before the bird plan analysis was applied. It was decided that this was just too many bird species. But to apply an "off-the-list" cut would necessarily eliminate priority status in Nevada of many conservation plan priority species. An acceptable compromise was reached when a new threshold score was applied to the bird scores (14), and the species scoring 14 and above were retained in the Species of Priority List while the species scoring 13 and below were designated Stewardship Species, or species of priority in one of the bird conservation plans that occurred in Nevada but were not necessarily at serious conservation risk or for which Nevada's role in the species' overall conservation was not particularly critical.

Through this designation, Nevada recognized its stewardship role in the conservation of those species, and assumed that conservation actions designed to meet the needs of the Species of Conservation Priority would also meet the needs of the Stewardship Species without focusing specifically on them. That basic stewardship assumption will be tested and evaluated annually to see if it still holds for the Stewardship Bird Species list based on the latest information. Species determined to warrant new specific focus will be elevated to the Species of Conservation Priority list as necessary. Currently, there are 64 bird Species of Conservation Priority and 51 Stewardship Bird Species.

2005 Wildlife Action Plan: Game Animals

Methods

Species classified as game animals in Nevada Administrative Code were prioritized by the NDOW Game Bureau in January, 2005. A Species Ranking Matrix was developed by Game Bureau personnel using the categories below.

1. *Population Status*

- Population status is at carrying capacity or is over-abundant. Numbers are believed to be as high as can be expected under current circumstances.
- Population status is below carrying capacity but is not being affected by major factors.
- Population is considered below carrying capacity but is not known to be affected by any natural or human factors.
- Population is considered below carrying capacity because of known natural or human influences.
- Population is considered well below carrying capacity. Remedial action is urgent in order to ensure species retention within most or all of its range.

2. *Population Trend*

- Population is increasing well through natural recruitment. There is no need for human intervention.
- Population is improving due to past or current remedial actions via human intervention.
- Population is neither improving nor declining.
- Population is declining but the trend can be corrected through remedial action via human intervention.
- Population is declining rapidly and is likely to disappear over much or all of its range without profound intervention.

3. *Population Distribution in Nevada*

- Populations occur within all suitable habitat in Nevada.
- Populations occur within most suitable habitat in Nevada, and can occupy all suitable habitat via human intervention
- Populations do not occur within all suitable habitat but expansion is not limited by any known factors.

- Population distribution is diminishing but formerly occupied range can be repopulated via human intervention.
- Population distribution is diminishing and urgent remedial action is needed to restore the species to its former range.

4. Population Distribution Within the Species' Range

- The species is not endemic to Nevada.
- The species is common in Nevada and throughout its total range.
- The species is not common in Nevada but is elsewhere outside of Nevada.
- The species is not common within total occupied range and population range within Nevada is important to the overall status of the species.
- The species' existence in Nevada represents a significant portion of its total range.

5. Habitat Status

- Nothing can be done. Habitat has been significantly diminished through natural actions and cannot be restored. Or, the habitat has been converted for human use and cannot be restored. Or, the species in non-endemic and only exists in this habitat via human intervention.
- Habitat is ecologically sound throughout all or a majority of the species' range. Habitat is widespread. Threats to the condition of the habitat do not appear imminent.
- Habitat is not imperiled by human action but condition can vary widely as a result of natural influences.
- Habitat occupied by the species can easily support the species but can also be easily improved through human intervention.
- All or a majority of the habitat occupied by the species is in poor ecological condition throughout all or a majority of the species' range but can be improved through human intervention.

6. Habitat Trend

- The ecological status of the habitat is stable and total area or condition is not likely to decline.
- The ecological status of the habitat is stable but is threatened with decline due to human actions.
- The ecological status of a significant portion of the habitat is declining due to widespread calamity.
- Preventable human-influenced land actions and/or natural processes are degrading much of the habitat within the natural range of the species.
- Urgent and significant remedial action is necessary to prevent the species' disappearance within remaining habitat.

7. Planning Rank

- The species can continue to exist in good numbers independent of human intervention. The species is not negatively affected by human influences.
- State, federal, or local planning efforts are already established and NDOW has committed to

participate in or take the lead in restorative or improvement actions.
- The species is presently managed for recovery under the Endangered Species Act.
- No planning efforts exist for this species but other criteria suggest that planned actions are necessary to improve the species or prevent its continued decline.
- Protection of the species under the Endangered Species Act appears imminent unless state actions occur that prevent further decline.

8. *Data Needs*

- NDOW collects good data at present that contributes to confident assessments of the species' status and trend.
- NDOW collects enough data at present that contributes to fair understanding of the species' status and trend to justify NDOW's management actions.
- NDOW does not have considerable data about the species status and trend in Nevada, but the species is believed to exist in numbers such that data collection is not considered a priority at this time.
- NDOW believes that additional data for this species is mandated to justify continued management actions.
- NDOW knows nothing about this species within Nevada.

9. *Human Interest*

Each game animal score received a human interest adjustment to reflect the amount of stakeholder interest in each species as it would affect Game Bureau program priority. The adjustment was calculated as the average of five criteria rankings considering the following concepts.

Species has significant economic importance to the state.

0 – has no perceivable impact on local or state economy
5 – recreation or science-based activities contribute significantly to local or state economies

Species has significant economic importance to NDOW's budget.

0 – few document sales attributed to the specific pursuit of this species
5 – document sales for this species are among the top five income sources for NDOW.

Expressed desire to pursue this species is greater than the limitations on the opportunity to do so.

0 – there are no regulatory restrictions upon persons wishing to pursue this species
5 – application rates for available tags are among the highest in the state.

Species status is a factor in other agencies' planning processes

0 – impacts to this species are not considered within land use decision processes.
5 – the status of this species is the top priority within land use decision processes.

Results

Total species score resulted from the simple addition of the nine criteria scores and species were ranked from highest (mule deer at 28.8) to lowest score (Rocky Mountain goat – 10.2). The selection of Game Animals of Conservation Priority was made through an intuitive assessment of where on the list a clear demarcation between the species of the most population conservation concern and the next tier of species. This resulted in the addition of 10 game species for inclusion in the CWCS Species of Conservation Priority list, as listed below.

Mule deer
Nelson bighorn sheep
Greater Sage-Grouse
Mountain Quail
American Marten (cross-ranked in the nongame species priority matrix and already included)
Canvasback
Redhead
Lesser Scaup
Blue Grouse
Northern River Otter (also cross-ranked in the nongame SPM)
Columbia Sharp-tailed Grouse
California bighorn sheep

Expert review

The Game Animal Species Ranking Matrix was distributed for internal review within the Game Bureau in January, 2005. It has received no external expert review to date.

Cross-ranking of species

Because of lack of funding and the urgency of other priorities, the Game Bureau shares some common program focus with the Wildlife Diversity Bureau for a few species classified as game animals or furbearers. Over the years, the Wildlife Diversity Bureau has provided program support for Greater Sandhill Cranes, American marten, mink, northwestern otter, and other mustelilds despite their game animal or furbearer classification status. Wildlife Diversity biologists have recently expressed concern for the conservation status of kit fox, ringtail, and Sierra Nevada red fox, and since these species are of very little economic importance in the Nevada fur trade, they were cross-ranked in the nongame Species Diversity Matrix. Recent stakeholder concerns over the conservation status of pygmy rabbit and the likelihood that a conservation planning process might ensue for the species prompted conservation planning responsibility to be shifted to the Wildlife Diversity Bureau and pygmy rabbit, which scored above the cut in the nongame matrix anyway, was included on the Species of Conservation Priority list. Game animals or furbearers that have been added to the Species of Conservation Priority list because of Wildlife Diversity Bureau priority are listed below.

Greater Sandhill Crane
Pygmy rabbit
Ringtail
Kit fox
Sierra Nevada red fox

Adjustments to Species of Conservation Priority list following stakeholder input

After stakeholder input was solicited and received through March and April, 2005, several adjustments were made to the Species of Conservation Priority list based on expert recommendations. At the suggestion of herpetologists from southern Nevada, the western diamondback rattlesnake was added to the reptiles of Conservation Priority based on the expressed concern over the conservation risk of the species within its extremely limited range in Nevada. Other species added to the list after stakeholder review included

Long-eared myotis
Hoary bat
Desert kangaroo rat
Wyoming ground squirrel (*nevadensis*)
Panamint alligator lizard

Merriam's ground squirrel was removed from the list as a result of stakeholder review and replaced by Wyoming ground squirrel (*nevadensis*).

At the suggestion of a waterfowl hunters/experts focus group, the Northern Pintail was added to the Conservation Priority list based on continued nationwide conservation concern for the species, and Cinnamon Teal was added because of Nevada's stewardship responsibility for the maintenance of the world's breeding population. At the request of this same group, the Lesser Scaup was removed from the Conservation Priority list because, despite the elevated nationwide conservation concern for the species, it was demonstrated that Nevada plays a role of very little significance in the overall conservation of the species.

2005 Wildlife Action Plan: Native Fish, Amphibians, Shellfish, Aquatic Reptiles, and Aquatic Insects

Methods

The first step in developing a list of aquatic species of greatest conservation priority was to develop a peer-reviewed list of aquatic species that occur in Nevada. Over a dozen sources of Nevada aquatics species names were used to develop a preliminary list. There was not always agreement among these sources regarding either scientific or common names. Therefore, standards were adopted for each aquatic taxon group (fish, amphibians, and shellfish) based on commonly accepted sources. The main standard for fish was the American Fisheries Society Special Publication 29 *Common and Scientific Names of Fishes from the United States, Canada, and Mexico*, sixth edition (2004) for species, and subspecies if available. If subspecies names were not available in that publication, NatureServe.org was used. NatureServe was also consulted for amphibian and mollusk common and scientific names. Don Sada, Desert Research Institute, Reno, Nevada, reviewed the gastropod list. The NW Freshwater Mussel Workgroup was utilized for bivalves. D. Christopher Rogers, invertebrate ecologist/taxonomist, EcoAnalysts, Inc., Woodland, California was consulted for crustacea. The list was then sent to known taxa experts for review and adjustment.

The process for developing the native Aquatic Species of Conservation Priority list criteria for CWCS evolved from pre-existing ranking criteria such as the Natural Heritage Scorecard methodology (Panjabi et al. 2001), Endangered Species Act listing criteria (USFWS 2005), IUCN (World Conservation Union) Red List Ranking (2004), protected status under Nevada Administrative Code and the matrix developed to rank NDOW's terrestrial/avian nongame species. The IUCN and ESA criteria are more geared to extinction risk than envisioned for our aquatic conservation list. Those criteria are focused on one end of the conservation risk scale – those of greatest risk of extinction. Although many native Nevadan aquatics, especially the fishes, fall into this category, the intention of this process was to rank species along the entire spectrum of conservation risk, including acknowledging where inadequate data exists to determine conservation risk.

NDOW's terrestrial/avian nongame species were ranked separately from the aquatics species primarily because aquatics species' distribution characteristics are a much larger contributing factor to their conservation need. Aquatic species, by definition, are linked to aquatic systems, which in Nevada tend to be isolated habitats more sensitive to local threats and stressors. That isolation and endemism are major contributing factors to their having the highest percentage of federally-listed species/subspecies of any wildlife taxon in Nevada (90 percent of Endangered, 75 percent of Threatened, and 80 percent of Candidate species). The same suite of factors that has contributed to protected status for many aquatic species is often also present for other unlisted aquatic species, but either to a lesser degree, or there is insufficient information to evaluate them. Most of the species on the aquatics species of greatest conservation priority list are already federally listed or state protected. In addition, many of the aquatic species that did not meet these highest levels of concern are subject to similar threats and stressors, particularly those affecting aquatic habitats and must be included in conservation planning so they do not decline to the point where it is necessary to increase their conservation ranking.

The following Species Priority Matrix criteria were developed to rank Nevada's native aquatics (if too little was known to rank a species for a criterion, then "unknown" was entered).

Endemism

Is the species/subspecies endemic to Nevada or does it have a regional/broad based natural distribution? For species that also occur outside of Nevada, do NV populations represent a significant focus of species distribution for conservation purposes?

1 = broad based, continental distribution

2 = species occurs naturally outside of NV, NV populations are peripheral or do not have significant conservation importance

3 = species occurs naturally outside of NV, NV populations have an important role in species conservation.

4 = species occurs naturally outside of NV, NV populations have a critical role in species conservation.

5 = species is Endemic to NV only

Population size/distribution (for snails, only the distribution portion was used for ranking)

Species has limited/restricted distribution and/or small population size(s) naturally or because of anthropogenic or other threats/impacts

1 = species is widely distributed (>10 locations) or large population sizes at multiple locations within Nevada.

2 = species has limited distribution in NV but populations are peripheral to range and not significant to species conservation (1 or 2 in Endemism category)

3 = species has restricted distribution (<10) or small population sizes (>2000 and <5,000 adult individuals) at two or more locations (fragmented or isolated distribution naturally or because of impacts)

4 = species occurs naturally at only one known location and/or small known total population size (<2,000 individuals).

Fragmentation

1 = species distribution is characterized by connectivity between locations of occurrence or is abundant in multiple expansive habitats.

2 = species has disjunct or fragmented distribution without significant connectivity between multiple locations of occurrence.

Population Trend

Increasing, stable, decreasing or unknown, based on available information.

1 = population trend of known populations is increasing over multiple years or is stable at capacity of occupied habitats.

2 = population trend of known populations is stable or moderately increasing/decreasing within expected natural levels of fluctuation (may be affected by less than optimum habitat in some of range or reduced from historic range/distribution). Stable, but below potential level.

3 = population trend of known populations may be showing decline or decrease due to anthropogenic or natural threats or loss of habitat quality/quantity at one or more known location(s) of occurrence.

4 = population trend of known populations is declining at one or more locations validated by survey and monitoring data or other methods.

Threats

Are there known, identifiable threats to the species or significant populations of the species? What is the severity/immediateness of those threats and can they be defined? Threats include, but are not limited to, habitat quality and quantity, known potential for habitat disturbance or deterioration, disease, predation, competition (with exotic or invasive species), and contaminants.

1 = future conditions are expected to remain stable or improved, no known substantive threats.

2 = future conditions expected to experience slight decline; current conditions are sustainable with minimal remedial action.

3 = future conditions have potential for moderate decline impacting species distribution, population sizes or trend; correctable with active management to address threat conditions.

4 = future conditions expected to experience severe decline significantly impacting species distribution or individual population(s); immediate, identifiable threats exist which need to be addressed by short-term and long-term management actions.

5 = Immediate action required; known, active threats are present which would significantly impact species persistence and viability, distribution, or result in local or widespread extirpation.

NDOW Ranking process/participants

The above ranking criteria were developed by the aquatics members of the CWCS team; then species lists were sent to regional NDOW staff for species ranking. If there was insufficient knowledge to rate a criterion for a species, it was marked “unknown.” If any of the five ranking criteria was marked “unknown,” then the species’ overall conservation need was ranked, based on best available information, as “high,” “med,” or “low” need). Some taxa (bivalves and crustacea) lacked sufficient information for most criteria; in that case experts were consulted for their estimation of risk.

Each NDOW Fisheries Bureau field and supervisory biologist was given an aquatic species list to rank. Meetings were then held with each region to discuss the individual rankings and pool them into a combined ranking list.

Dr. Donald Sada, an acknowledged expert on Nevada’s freshwater gastropods and spring systems, ranked the aquatic snails based on the ranking criteria above, with the exception that, as noted, the population size criteria was not applied. Freshwater snails may have populations exceeding 2,000 individuals at a site, but still be at high risk because of their extremely limited distribution

The Aquatic Species of Conservation Priority list ranking was completed by the Fisheries Bureau biologists’ team in December, 2004. In addition to providing ranking expertise, the Fisheries Bureau team provided a synopsis of information, by species, for the CWCS eight required elements. Since many of the aquatic species are already listed or otherwise recognized as needing focused conservation management, multi-partner conservation plans already exist for most of the aquatic Species of Conservation Priority. The Fisheries Bureau team used those currently existing planning efforts to summarize the information in the CWCS eight required elements in order to integrate the Nevada species prioritization/conservation planning process with existing species planning efforts.

Results

Score

The simple addition of the values from the five categories produced a score that could range from 5 (minimum score 1 in five categories) to 20 (maximum scores in all categories). Computed scores for fish ranged from 5 (generic speckled dace) to 20 (Moapa dace and Pahranagat roundtail chub).

The ranked list was then examined to see if there was a score that provided a natural break related to other ranking criteria such as ESA listing status, NNHP rank, state status, Forest Service, and BLM status. All species that were ESA listed had scores above 14 and we used that for the aquatic species of greatest conservation priority (ASGCP) cutoff. There were 39 species/subspecies of fish with a rank above 14, 23 of which are ESA-listed. Of the remaining 16 species with scores above 14, 14 are endemic only to Nevada and the other 2 are highly endemic or have a significant population decline. Thirty-three fish species fell below the cutoff; of these, 13 are either state protected or on a US Forest Service or BLM sensitive species list. It is important to consider that the ranking of a species or sub-species below the level of "greatest conservation need" does not indicate or suggest an absence of need for conservation actions for that species, or a need to revise or alter protected status. This is a process intended to provide a focus to the need for application of limited resources in some priority manner, and the ranking of risk is relative to other species considered, not to the absence of risk or conservation need at all.

A secondary analysis was performed on species rankings to see if there were species for which the matrix output did not provide adequate or accurate representation. Bull trout fell below the cutoff threshold but was elevated to the list of aquatic species of greatest conservation priority because it is federally listed as Threatened.

Expert review

Fish

The majority of the proposed fish Species of Conservation Priority have already gone through extensive expert review since they are federally or state protected and plans and conservation teams address their level of need. NDOW Fisheries Bureau biologists are considered the experts, or are among the experts for these fish species. All the NDOW fisheries field biologists, supervisory biologists, appropriate staff biologists, and the bureau chief participated in development and review of the species lists. The regional biologists also discussed CWCS with conservation plan partners and gave them information about accessing the CWCS documents on the web and providing comment. In addition, external species experts were informed of open house meetings scheduled for their areas where they could provide direct input to review and discussion of rankings and criteria.

Amphibians

As above, regional and staff biologists discussed CWCS with conservation plan partners and gave them information about accessing the CWCS documents on the web and providing comment, and were invited to open houses. In addition, a meeting was held in Las Vegas to discuss mammals and herptiles at which time more detailed information was provided and input solicited.

Shellfish (Bivalves, Gastropods, Crustaceans)

The acknowledged aquatic gastropod expert in Nevada, Dr. Sada, was directly involved in creating a prioritized list of snails, and Nevada's Natural Heritage Program (NNHP) was also consulted. Bivalve information and ranking information was provided by NNHP and the Northwest Freshwater Mussel Working Group. Since there is little documented information available on Nevada crustacea, a notice was posted on the Crustacea list serve and feedback was received, including information from D. Christopher Rogers, EcoAnalysts, Inc., an acknowledged expert for branchiopods.

Aquatic species of greatest conservation priority

As noted above, NDOW expertise in freshwater shellfish is rather limited; experts in specific taxa were consulted to provide general ranking information where it was otherwise lacking. The California floater, a freshwater mussel, was added to the list as it has a high state ranking through the Natural Heritage process and is ranked from Vulnerable to Critically Imperiled throughout its range. It is dependent on fish during an important phase in its life history, and its fate is therefore linked with that of fish and fish habitats.

Stewardship species

As noted above, the majority of the species that fell into the aquatic species of greatest conservation priority are already federally listed. Some species with other legal protections and ongoing conservation efforts fell below the matrix cutoff, but were noted by reviewers as worthy of special attention. These species are noted as Stewardship Species. They included Bonneville and Yellowstone cutthroat trout (refer to the species list in Appendix H for additional details). Although the majority of their range lies outside Nevada, the Nevada component of the population contributes to their conservation.

2005 Wildlife Action Plan: Non-native fish ranking

The CWCS is intended to address all state wildlife. Many non-native fish are very important economically to Nevada as sport fish, and some have an impact on conservation of native species, both positively and negatively. There are some exotics (e.g., tilapia) that cause considerable negative impact to Species of Conservation Priority. Providing good river and stream riparian habitats benefits both non-native and native trout species as well as native, non-game species of conservation concern which occupy those habitats. In order to balance the beneficial aspects of some non-native species and the negative impacts of others, non-native species were ranked for their importance to sport fisheries using criteria listed below. Most non-native game fish species are actively managed for sport fisheries at some level and are generally abundant within the aquatic habitats that they occupy. Because of this, and because of their introduced status, no non-native fishes have been identified as Species of Conservation Priority.

Any of the introduced fish species can exert a negative impact on native fish species through competition, predation, etc. The Nevada Department of Wildlife, however, goes to great lengths to prevent negative interaction between native fish species and non-native fish species. Management Plans written for the majority of the state's fishable lakes and reservoirs address competition issues prior to them becoming a problem. Also, since the majority of Nevada's lakes and reservoirs are artificial, there were no native species present to start with.

Annually, as part of NDOW's F-20 grant process, the potential impacts to native fishes as a direct result of stocking new waters or stocking new species into existing waters are evaluated. This is part of the Section 7 process for grant approval. NDOW's assessments are then reviewed by the Regional Office of the US FWS with input from the Nevada Field Office of the US FWS in Reno.

Methods

Extant non-native fish were prioritized by the NDOW Fisheries Bureau in December, 2004. A Species Ranking Matrix was developed by Fisheries Bureau Sport Fish Program personnel using the following categories.

Knowledge

Is information on Nevada species' distribution/populations/habitat requirements adequate for management?

1 = Very limited or no information
2 = Some information

3 = Information adequate

Legal Status

Game or nongame species.

1 = Nongame species

2 = Game species

Introduction

1 = Not planned

2 = Planned

Management Opportunity

1 = No plans to include in any planning process

2 = Not included in any planning process at the present time, but may be in the future.

3 = To be included in the planning process within the next 5 years.

4 = Species are included within present planning process in progress reports or species management plans.

Conservation Opportunity

1 = Would prefer to eliminate fish from state.

2 = Prefer to maintain populations within state.

Socioeconomic Evaluation

Value as a game species, commercial species, indicator species and/or prey species.

0 = Significant threat to extant native fish populations

1 = Low value

2 = Medium value

3 = High value

Threats

Threats to species as defined by human caused impacts (LMB virus, whirling disease, channel catfish virus, etc.).

1 = Low threat

2 = Medium threat

3 = High threat

Results

The simple addition of the values from the seven categories produced a score that could range from 6 (minimum scores in all categories) to 19 (maximum scores in all categories). Computed scores for fish ranged from 6 (tilapia, goldfish, mollies, etc.) to 18 (channel catfish, largemouth bass, rainbow trout). The list also indicates which species are considered undesirable in all or parts of Nevada because of their impacts on native fishes or desirable sport fishes.

Adjustments to Species of Conservation Priority list following stakeholder input

After stakeholder input was solicited and received through May, 2005, a few adjustments were made to the Aquatic Species of Conservation Priority/Stewardship lists based on expert recommendations. At the suggestion of herpetologists the Mountain Yellow-legged frog was added to the list. This species was not on the original list because it was believed to be extirpated from Nevada. However, after feedback and discussion with experts and stakeholders, it was decided to include it on the list in the event that any are found in Nevada in the future.

Based on discussions with Nevada Natural Heritage Program staff, the California floater was also added to the list. It is ranked by NNHP as Critically Imperiled in Nevada and is rated from Vulnerable to Critically Imperiled throughout its range.

Species that were mentioned fairly frequently during the stakeholder/partner process were eastern Nevada trout species, particularly Bonneville and Yellowstone cutthroat trout. They did not rank high during the matrix analysis because ongoing conservation plans and actions have succeeded in reducing risk. However, these actions need to continue in order to maintain the progress made in their conservation, and they should be considered in land management and other conservation actions.

Expert review of aquatic species of conservation priority

Fish

The majority of the proposed fish species of conservation priority have already gone through extensive peer review since they are federally or State protected and plans and conservation teams address their level of need.

NDOW Fisheries Bureau biologists are considered the experts, or are among the experts for these fish species. All the NDOW fisheries field biologists, supervisory biologists, appropriate staff biologists, and the bureau chief participated in development and review of the species lists. The regional biologists also discussed.

CWCS with conservation plan partners and gave them information about accessing the CWCS documents on the web and providing comment. In addition, external species experts were informed of open house meetings scheduled for their areas where they could provide direct input to review and discussion of rankings and criteria.

Amphibians

As above, regional and staff biologists discussed CWCS with conservation plan partners and gave them information about accessing the CWCS documents on the web and providing comment, and were invited to open houses. In addition, a meeting was held in Las Vegas to discuss mammals and herptiles, at which time more detailed information was provided and input solicited.

Shellfish

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Table 1. Results of applying the Climate Change Vulnerability Index (CCVI) to Nevada's Species of Conservation Priority (see next page).

Nevada Natural Heritage Program

NatureServe Climate Change Vulnerability Index (CCVI), Release 2.01

Assessment Results for the Nevada Species of Conservation Priority (SOCP)
Abridged version, March 21, 2012

Group	Species	English Name	GRank	SRank	Natl barriers B2a	Anth barriers B2b	CC mitigation B3	Dispersal/Movement C1	historical thermal niche C2ai	physiological thermal niche C2aii	historical hydrological niche C2bi	physiological hydrological niche C2bii	Disturbance C2c	Ice/snow C2d	Phys habitat C3	Other spp for hab C4a	Diet C4b	Other spp disp C4d	Genetic var C5a	Gen bottleneck C5b	Phenol response C6	Doc response D1	Index	Conf.
Invert-Mollusk	*Anodonta californiensis*	California floater	G3Q	S1	N	N	N	SI	N-SD	N	Inc	GI-Inc	N	N	SD	N	N	SI-N	U	U	U	U	MV	Mod
Invert-Mollusk	*Eremopyrgus eganensis*	Steptoe hydrobe	G1	S1	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Fluminicola dalli*	Pyramid Lake pebblesnail	G1	SNR	GI	N	N	SI	N	N	Inc	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Fluminicola turbiniformis*	turban pebblesnail	G3	SNR	GI	N	N	SI	N	N	SI	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Fluminicola virginius*	Virginia Mountains pebblesnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Juga interioris*	smooth juga	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis aloba*	Duckwater springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis anatina*	southern Duckwater springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis anguina*	longitudinal gland springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis augustae*	elongate Cain Spring springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis aurata*	Pleasant Valley springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis avernalis*	Moapa pebblesnail	G1G2	S1S2	GI	N	N	SI	SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis basiglans*	large gland Carico springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis bifurcata*	small gland Carico springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis breviloba*	Flag springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis bruesi*	Fly Ranch springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	HV	Low
Invert-Mollusk	*Pyrgulopsis carinifera*	Moapa Valley springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis coloradensis*	Blue Point springsnail	GH	SH	GI	N	N	SI	N	N	GI	GI-Inc	N	N	N	N	N	N	U	U	U	U	MV	VH
Invert-Mollusk	*Pyrgulopsis cruciglans*	transverse gland springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis crystalis*	Crystal Spring springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis deaconi*	Spring Mountains springsnail	G1	S1	GI	N	N	SI	N	N	SI	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis dixensis*	Dixie Valley springsnail	G1	S1	GI	N	N	SI	SD	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	MV	VH
Invert-Mollusk	*Pyrgulopsis erythropoma*	Ash Meadows pebblesnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis fairbanksensis*	Fairbanks springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis fausta*	Corn Creek springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH

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					Natl barriers	Anth barriers	CC mitigation	Dispersal/Movement	historical thermal niche	physiological thermal niche	historical hydrological niche	physiological hydrological niche	Disturbance	Ice/snow	Phys habitat	Other spp for hab	Diet	Other spp disp	Genetic var	Gen bottleneck	Phenol response	Doc response		
Group	**Species**	**English Name**	**GRank**	**SRank**	**B2a**	**B2b**	**B3**	**C1**	**C2ai**	**C2aii**	**C2bi**	**C2bii**	**C2c**	**C2d**	**C3**	**C4a**	**C4b**	**C4d**	**C5a**	**C5b**	**C6**	**D1**	**Index**	**Conf.**
Invert-Mollusk	*Pyrgulopsis gracilis*	Emigrant springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis hovinghi*	Upper Thousand Spring springsnail	G1	S1	GI	N	N	SI	N	N	GI	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis hubbsi*	Hubbs springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis humboldtensis*	Humboldt springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis imperialis*	Kings River springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis isolata*	elongate-gland springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis landyei*	Landyes springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis lata*	Butterfield springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis leporina*	Elko pyrg	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis limaria*	squat Mud Meadows springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis lockensis*	Lockes springsnail	G1	S1	GI	N	N	SI	SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis marcida*	Hardy springsnail	G1	S1	GI	N	N	SI	SD	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis merriami*	Pahranagat pebblesnail	G1	S1	GI	N	N	SI	SD	N	Inc	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis micrococcus*	Oasis Valley springsnail	G3	S2	GI	N	N	SI	N	N	GI	SI	N	N	N	N	N	N	U	U	U	U	MV	VH
Invert-Mollusk	*Pyrgulopsis militaris*	northern Soldier Meadow pyrg	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis millenaria*	Twentyone Mile springsnail	G1	S1	GI	N	N	SI	SD	N	GI	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis montana*	Camp Valley springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis nanus*	distal-gland springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis neritella*	neritiform Steptoe Ranch springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis notidicola*	elongate Mud Meadows springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis orbiculata*	sub-globose Steptoe Ranch springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis papillata*	Big Warm Spring springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis peculiaris*	bifid duct springsnail	G2	S1	GI	N	N	SI	N	N	Inc	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis pellita*	Antelope Valley springsnail	G1	S1	GI	N	N	SI	N	N	GI	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis pictilis*	ovate Cain Spring springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH

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Invert-Mollusk	*Pyrgulopsis pisteri*	median-gland springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis planulata*	flat-topped Steptoe springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis sadai*	Sada's springsnail	G1G2	S1S2	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis sathos*	White River Valley springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis serrata*	northern Steptoe springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis sterilis*	sterile basin springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis sublata*	Lake Valley springsnail	G1	S1	GI	N	N	SI	N	N	GI	GI	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis sulcata*	southern Steptoe springsnail	G1	S1	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis turbatrix*	southeast Nevada springsnail	G2	S2	GI	N	N	SI	N	N	Inc	SI	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis umbilicata*	southern Soldier Meadow springsnail	G1Q	S1	GI	N	N	SI	N	N	GI	Inc-SI	N	N	N	N	N	N	U	U	U	U	HV	VH
Invert-Mollusk	*Pyrgulopsis variegata*	northwest Bonneville springsnail	G2	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis villacampae*	Duckwater warm springs springsnail	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Pyrgulopsis vinyardi*	Vinyard's springsnail	G1	S1	GI	N	N	SI	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	EV	VH
Invert-Mollusk	*Pyrgulopsis wongi*	Wong's pyrg	G2	S1	GI	N	N	SI	SD	N	Inc	SI	N	N	N	N	N	N	U	U	U	U	MV	VH
Invert-Mollusk	*Tryonia angulata*	sportinggoods tryonia	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Tryonia clathrata*	grated tryonia	G2	S2	GI	N	N	SI	N-SD	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Tryonia elata*	Point of Rocks tryonia	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Tryonia ericae*	minute tryonia	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Tryonia monitorae*	Monitor tryonia	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Invert-Mollusk	*Tryonia variegata*	Amargosa tryonia	G2	S2	GI	N	N	SI	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Catostomus clarki intermedius*	White River desert sucker	G3G4T1T2Q	S1S2	GI	N	N	N	SD	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	HV	VH
Fish	*Catostomus clarkii ssp. 2*	Meadow Valley Wash desert sucker	G3G4T2	S2	GI	U	N	SD-Dec	N	N	Inc-SI	SI	SI-N	N	SD	N	N	N	U	U	U	U	PS	Low
Fish	*Catostomus latipinnis*	flannelmouth sucker	G3G4	S1	N	SI	N	Dec	SD	N	GI	N	SI	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Catostomus sp. 1*	Wall Canyon sucker	G1	S1	N	N	N	SD	N	N	GI	GI-Inc	N	N	N	N	N	N	U	U	U	U	MV	VH
Fish	*Chasmistes cujus*	cui-ui	G1	S1	GI	SI	N	SD	SD	N	Inc	GI-N	N	N	N	N	N	N	U	U	U	U	MV	VH

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Fish	*Crenichthys baileyi albivallis*	Preston White River springfish	G2T1	S1	GI	N	N	N-SD	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Crenichthys baileyi baileyi*	White River springfish	G2T1	S1	GI	N	N	N	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Crenichthys baileyi grandis*	Hiko White River springfish	G2T1	S1	GI	N	N	N-SD	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Crenichthys baileyi moapae*	Moapa White River springfish	G2T2	S2	Inc	SI	N	SD	SD	SD	GI	SI	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Crenichthys baileyi thermophilus*	Moorman White River springfish	G2T1	S1	GI	N	N	SD	SD	SD	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Crenichthys nevadae*	Railroad Valley springfish	G2	S2	GI	N	N	SD	SD	SD	Inc	N	SI-N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Cyprinodon diabolis*	Devils Hole pupfish	G1	S1	GI	N	N	N	N	N	GI	N	N	N	N	N	N	N	U	Inc	U	U	PS	VH
Fish	*Cyprinodon nevadensis mionectes*	Ash Meadows Amargosa pupfish	G2T2	S2	GI	N	N	SD	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Cyprinodon nevadensis pectoralis*	Warm Springs pupfish	G2T1	S1	GI	N	N	SD	N	N	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Empetrichthys latos*	Pahrump poolfish	G1T1	S1	GI	N	N	SD	SD	N	Inc	GI-N	N	N	N	N	N	N	U	U	U	U	MV	VH
Fish	*Eremichthys acros*	desert dace	G1	S1	GI	SI	N	SD	N	SD	GI	Inc	N	N	SD	N	N	N	U	U	U	U	MV	VH
Fish	*Gila alvordensis*	Alvord chub	G2	S2	GI	U	N	SD	N	N	GI-Inc	Inc-SI	SI-N	N	SD	N	N	N	U	U	U	U	HV	Low
Fish	*Gila bicolor eurysoma*	Sheldon tui chub	G4T1	S1	GI	U	N	SD-Dec	N	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Gila bicolor isolata*	Independence Valley tui chub	G4T1Q	S1	N	N	N	SD	N-SD	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	PS	Low
Fish	*Gila bicolor ssp. 4*	Fish Lake Valley tui chub	G4T1Q	S1	N	N	N	SD	SD	N	GI	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Gila bicolor ssp. 6*	Little Fish Lake Valley tui chub	G4T1	S1	GI	U	N	SD-Dec	N	N	GI	Inc-SI	SI-N	N	SD	N	N	N	U	U	U	U	HV	Mod
Fish	*Gila bicolor ssp. 7*	Railroad Valley tui chub	G4T1Q	S1	GI	N	N	SD	SD	N	Inc	GI	N	N	SD	N	N	N	U	U	U	U	MV	VH
Fish	*Gila bicolor ssp. 8*	Big Smoky Valley tui chub	G4	T1	GI	N	N	SD	N-SD	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Gila bicolor ssp. 9*	Dixie Valley tui chub	G4T1Q	S1	GI	U	N	SD-Dec	SD	N	GI-Inc	Inc-SI	N	N	SD	N	N	N	U	U	U	U	PS	High
Fish	*Gila elegans*	bonytail	G1	S1	N	SI	N	Dec	N	N-SD	GI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Fish	*Gila robusta jordani*	Pahranagat roundtail chub	G3T1	S1	Inc	Inc	N	SD	N	Inc	GI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Gila seminuda*	Virgin River chub	G1	S1	SI	SI	U	SD	SD	N	GI	SI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Lepidomeda albivallis*	White River spinedace	G1	S1	GI	N	N	SD	SD	N	GI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Lepidomeda mollispinis mollispinis*	Virgin River spinedace	G1G2T1	S1	N	N	N	SD	SD	N	Inc	SI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Lepidomeda mollispinis pratensis*	Big Spring spinedace	G1G2T1	S1	GI	N	N	SD	SD	N	GI	SI	SI	N	SD	N	N	N	U	U	U	U	MV	VH

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Fish	*Moapa coriacea*	Moapa dace	G1	S1	GI	N	N	SD	SD	SD	GI	N	U	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Oncorhynchus clarki henshawi*	Lahontan cutthroat trout	G4T3	S3	SI	SI	N	Dec	SD	Inc	N	Inc	SI	N	SD	N	N	N	U	U	U	U	MV	VH
Fish	*Oncorhynchus clarkii bouvieri*	Yellowstone cutthroat trout	G4T2	S1	GI	U	N	SD	N-SD	N	SI	GI	N	N	SD	N	N	N	U	U	U	U	MV	VH
Fish	*Oncorhynchus mykiss pop. 4*	Warner Valley Redband Trout	G5T2Q	S2	GI	U	N	SD	N	N	GI	Inc	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Plagopterus argentissimus*	woundfin	G1	S1	SI	Inc	N	SD	SD	N	GI	SI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Prosopium williamsoni*	mountain whitefish	G5	S3	GI	U	N	SD	N	SI-N	SI-N	Inc	N	N	SD	N	N	N	U	U	U	U	MV	Mod
Fish	*Relictus solitarius*	relict dace	G2G3	S2S3	GI	N	N	N	N-SD	N	Inc-SI	SI	N	N	SD	N	N	N	U	U	U	U	MV	Mod
Fish	*Rhinichthys osculus lariversi*	Big Smoky Valley speckled dace	G5T1	S1	GI	N	N	SD	N	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Rhinichthys osculus lethoporus*	Independence Valley speckled dace	G5T1	S1	GI	N	N	SD	N-SD	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Rhinichthys osculus moapae*	Moapa speckled dace	G5T1	S1	GI	N	N	SD	SD	N	GI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Rhinichthys osculus nevadensis*	Ash Meadows speckled dace	G5T1	S1	GI	N	N	SD	N	N	GI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Rhinichthys osculus oligoporus*	Clover Valley speckled dace	G5T1	S1	GI	N	N	SD	N-SD	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Rhinichthys osculus ssp. 10*	Diamond Valley speckled dace	G5TH	SH	GI	N	N	SD	N-SD	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Rhinichthys osculus ssp. 11*	Meadow Valley speckled dace	G5T2	S2	GI	U	N	SD	N-SD	N	SI	SI	SI-N	N	SD	N	N	N	U	U	U	U	PS	Mod
Fish	*Rhinichthys osculus ssp. 5*	Monitor Valley speckled dace	G5T1	S1	GI	N	N	SD	N	N	GI	GI	N	N	SD	N	N	N	U	U	U	U	HV	VH
Fish	*Rhinichthys osculus ssp. 6*	Oasis Valley speckled dace	G5T1	S1	Inc	N	N	SD	N	N	GI	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Rhinichthys osculus ssp. 7*	White River speckled dace	G5T2T3Q	S2S3	Inc	N	N	SD	SD	N	GI	Inc	N	N	SD	N	N	N	U	U	U	U	MV	VH
Fish	*Rhinichthys osculus velifer*	Pahranagat speckled dace	G5T1Q	S1	GI	N	N	SD	N	N	GI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Fish	*Salvelinus confluentus pop. 4*	bull trout	G3T2Q	S1	Inc	N	N	SD	N-SD	GI	N	GI	SI	N	SD	N	N	N	U	U	U	U	HV	Low
Fish	*Xyrauchen texanus*	razorback sucker	G1	S1	N	SI	N	Dec	N	N-SD	GI	N	N	N	N	N	N	N	SD	N/A	U	U	IL	Low
Amphibian	*Anaxyrus boreas*	western toad	G4T4	S3S4	N	N	N	SD	N-SD	N	N	Inc	N	N	N	N	N	N	U	U	U	U	PS	VH
Amphibian	*Anaxyrus cognatus*	Great Plains toad	G5	S2	N	SI	U	N	SD	N	Inc	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Amphibian	*Anaxyrus microscaphus*	Arizona toad	G3G4	S2	N	SI	N	N	SD	N	Inc	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Amphibian	*Anaxyrus nelsoni*	Amargosa toad	G2	S2	N	N	N	N	N	N	GI	Inc	N	N	N	N	N	N	U	U	U	U	PS	VH
Amphibian	*Lithobates onca*	relict leopard frog	G1	S1	GI	N	N	SI	N	N	GI	N	N	N	SD	N	N	N	SI	N/A	U	U	MV	VH

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Group	Species	English Name	GRank	SRank	Natl barriers B2a	Anth barriers B2b	CC mitigation B3	Dispersal/Movement C1	historical thermal niche C2ai	physiological thermal niche C2aii	historical hydrological niche C2bi	physiological hydrological niche C2bii	Disturbance C2c	Ice/snow C2d	Phys habitat C3	Other spp for hab C4a	Diet C4b	Other spp disp C4d	Genetic var C5a	Gen bottleneck C5b	Phenol response C6	Doc response D1	Index	Conf.
Amphibian	*Lithobates pipiens*	northern leopard frog	G5	S2S3	SI	SI	N	SD	SD	N	Inc-SI	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Amphibian	*Rana luteiventris*	Columbia spotted frog (Toiyabe sub-population)	G4T2T3Q	S2S3	N	Inc	N	N	N-SD	N	N	GI	SI	SI	SD	N	N	N	U	U	U	U	HV	Low
Amphibian	*Rana luteiventris*	Columbia spotted frog (NE sub-population)	G4T2T3Q	S2S3	Inc	SI	N	N	N-SD	N	N	GI	Inc	N	SD	N	N	N	U	U	U	U	HV	Low
Amphibian	*Rana sierrae*	Sierra Nevada mountain yellow-legged frog	G1G2	SH	N	N	N	N	N	N	SI	GI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Amphibian	*Spea intermontana*	Great Basin spadefoot	G5	S4	N	SI-N	Inc	SD	N-SD	N	SI	SI	SI	N	SD	N	N	N	U	U	U	U	MV	Mod
Reptile	*Actinemys marmorata marmorata*	northwestern pond turtle	G3G4	S3	N	N	N	SD	SD	N	Inc	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Charina bottae*	northern rubber boa	G5	S3S4	SI-N	SI-N	N	N-SD	N-SD	N	N	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Chionactis occipitalis*	Mohave (or Mojave) shovel-nosed snake	G5	S4	SI	SI	Inc	N-SD	SD	N	GI-Inc	N	N	N	SI	N	N	N	U	U	U	U	MV	VH
Reptile	*Coleonyx varigatus*	western banded gecko	G5	S4	SI	SI	Inc	N	SD	N	Inc	N	SI	N	SD	N	N	N	U	U	U	U	MV	VH
Reptile	*Crotalus cerastes*	sidewinder	G5	S4	SI	SI	Inc	N-SD	SD	N	Inc-SI	N	N	N	SI	N	N	N	U	U	U	U	MV	VH
Reptile	*Crotaphytus bicinctores*	Great Basin collared lizard	G5	S4	N	N	Inc	N	SD	N	SI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Reptile	*Diadophis punctatus*	ring-necked snake	G5	S3	SI	SI	Inc	N	N-SD	N	Inc-SI	N	N	N	SD	N	N	N	U	U	U	U	MV	Mod
Reptile	*Dipsosaurus dorsalis*	desert iguana	G5	S3	SI	SI	Inc	N	SD	N	Inc-SI	N	SI	N	SI-N	N	N	N	U	U	U	U	MV	Mod
Reptile	*Elgaria coerulea palmeri*	Sierra alligator lizard	G5T4	S2S3	N	N	N	N	N	SI	N	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Elgaria coerulea shastensis*	Shasta alligator lizard	GT4	SNR	N	N	N	N	N	GI	GI-Inc	N	N	N	SD	N	N	N	U	U	U	U	MV	VH
Reptile	*Elgaria panamintina*	Panamint alligator lizard	G2G3	SNR	N	N	N	N	N	SI	GI-Inc	N	SI-N	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Gambelia wislizenii*	long-nosed leopard lizard	G5	S4	N	N	Inc	N	N	N	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Gopherus agassizii*	desert tortoise	G4	S2	SI	SI	Inc	SD	SD	N	Inc	N	SI	N	N	N	N	N	U	U	U	U	PS	VH
Reptile	*Heloderma suspectum*	Gila monster	G4	S2	SI	SI	Inc	N	SD	N	Inc-SI	N	SI-N	N	SD	N	N	N	Inc	N/A	U	U	HV	Mod
Reptile	*Lampropeltis pyromelana*	Sonoran mountain kingsnake	G4G5	S2	Inc	N	N	N	N	SI	Inc	N	SI	N	SD	N	N	N	U	U	U	U	HV	VH
Reptile	*Lichanura trivirgata*	Mexican rosy boa	G4G5	SNR	SI	SI	Inc	N-SD	N	SI-N	GI-Inc	N	N	N	SD	N	N	N	U	U	U	U	PS	Mod
Reptile	*Phrynosoma douglasii*	pygmy short-horned lizard	G5	SNR	N	N	SI	N	N	N	SI-N	N	SI	N	N	N	SI	N	U	U	U	U	MV	Low
Reptile	*Phrynosoma hernandesi*	greater short-horned lizard	G5	S3	N	N	SI	N	N-SD	N	N	N	N	N	N	N	SI	N	U	U	U	U	PS	VH
Reptile	*Phrynosoma platyrhinos*	desert horned lizard	G5	S4	N	N	Inc	N	SD	N	SI-N	N	N	N	N	N	SI	N	U	U	U	U	PS	Low
Reptile	*Phyllorhynchus decurtatus*	spotted leaf-nosed snake	G5	S4	N	SI	Inc	N-SD	SD	N	GI-Inc	N	SI	N	SD	N	N	N	U	U	U	U	PS	Mod

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Group	**Species**	**English Name**	**GRank**	**SRank**	**B2a**	**B2b**	**B3**	**C1**	**C2ai**	**C2aii**	**C2bi**	**C2bii**	**C2c**	**C2d**	**C3**	**C4a**	**C4b**	**C4d**	**C5a**	**C5b**	**C6**	**D1**	**Index**	**Conf.**
Reptile	*Plestiodon gilberti rubricaudatus*	western red-tailed skink	G5	S2	Inc	N	N	N	N	SI	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Rena humilis*	western threadsnake	G5	S4	SI	SI	Inc	SI-N	SD	N	Inc	N	SI	N	N	N	N	N	U	U	U	U	MV	VH
Reptile	*Sauromalus obesus*	chuckwalla	G5	S3	SI	SI	Inc	N	SD	N	Inc	N	SI	N	SD	N	N	N	U	U	U	U	MV	VH
Reptile	*Tantilla hobartsmithi*	Smith's black-headed snake	G5	S4	SI	N	Inc	N-SD	SD	N	GI-Inc	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Reptile	*Urosaurus graciosus*	western brush lizard	G5	S4	SI	SI	Inc	N	N	N	Inc	N	SI	N	N	N	N	N	U	U	U	U	HV	VH
Reptile	*Xantusia vigilis*	desert night lizard	G5	S4	SI	SI	Inc	N	SD	N	Inc	N	SI	N	SD	SI	N	N	U	U	U	U	MV	VH
Bird	*Accipiter gentilis*	northern goshawk	G5	S2	N	N	Inc	Dec	N	N	SD	SI	Inc	N	N	SI	N	N	U	U	U	U	MV	VH
Bird	*Agelaius tricolor*	tricolored blackbird	G2G3	S1B	N	N	N	Dec	SI-N	N	GI	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Amphispiza belli*	sage sparrow	G5	S4B	N	N	Inc	Dec	N-SD	N	SI	N	Inc	N	SD	GI-Inc	N	N	U	U	U	U	MV	Mod
Bird	*Anas acuta*	northern pintail	G5	S5	N	N	Inc	Dec	SD	N	N	GI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Aquila chrysaetos*	golden eagle	G5	S4	N	N	Inc	Dec	SD	N	SI-N	N	N	N	SI	N	N	N	U	U	U	U	PS	VH
Bird	*Asio flammeus*	short-eared owl	G5	S4	N	N	Inc	Dec	SD	N	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Athene cunicularia hypugaea*	western burrowing owl	G4	S3B	N	N	Inc	Dec	N-SD	N	SI	N	N	N	N	SI	N	N	U	U	U	U	PS	VH
Bird	*Aythya americana*	redhead	G5	S4	N	N	Inc	Dec	N	N	SI-N	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Aythya valisineria*	canvasback	G5	S3	N	N	Inc	Dec	N	N	SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Botaurus lentiginosus*	American bittern	G4	S3B	N	N	Inc	Dec	N	N	SI	Inc	SI-N	N	SD	N	N	N	U	U	U	U	MV	Low
Bird	*Buteo regalis*	ferruginous hawk	G4	S2	N	N	Inc	Dec	N	N	SI-N	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Calidris mauri*	western sandpiper	G5	S5M	N	N	Inc	Dec	SI-N	N	Inc-SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	Low
Bird	*Carpodacus cassinii*	Cassin's finch	G5	S5	N	N	SI	Dec	N	N	N	N	Inc	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Centrocercus urophasianus*	greater sage-grouse	G4	S3S4	N	N	Inc	SD	SD	SI	SI	N	Inc	N	SD	GI-Inc	SI	N	U	U	U	U	HV	Low
Bird	*Charadrius alexandrinus nivosus*	western snowy plover	G4T3	S3B	N	N	Inc	Dec	N	N	Inc-SI	Inc	SI	N	SI-N	N	SI-N	N	U	U	U	U	MV	Mod
Bird	*Chlidonias niger*	black tern	G4	S2S3B	N	N	Inc	Dec	N	N	Inc-SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Chordeiles minor*	common nighthawk	G5	S5B	N	N	Inc	Dec	SI	N	SI-N	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Coccyzus americanus occidentalis*	western yellow-billed cuckoo	G5T3Q	S1B	N	N	Inc	Dec	SI-N	SI-N	GI-Inc	SI-N	N	N	SD	SI-N	SI	N	U	U	U	U	MV	Low
Bird	*Colaptes chrysoides*	gilded flicker	G5	S1	N	N	Inc	Dec	N	N	Inc	N	N	N	SD	GI-Inc	N	N	U	U	U	U	PS	VH

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Group	**Species**	**English Name**	**GRank**	**SRank**	**B2a**	**B2b**	**B3**	**C1**	**C2ai**	**C2aii**	**C2bi**	**C2bii**	**C2c**	**C2d**	**C3**	**C4a**	**C4b**	**C4d**	**C5a**	**C5b**	**C6**	**D1**	**Index**	**Conf.**
Bird	*Contopus cooperi*	olive-sided flycatcher	G4	S2B	N	N	Inc	Dec	N	N	N	N	SD	N	SD	N	N	N	U	U	U	U	IL	VH
Bird	*Dendragapus fuliginosus*	sooty grouse	G5	SNR	Inc-SI	N	N	SD-Dec	N	N	N-SD	N	Inc-SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Dendragapus obscurus*	dusky grouse	G5	S3	N	N	Inc	SD-Dec	N-SD	N	N-SD	N	Inc-SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Dolichonyx oryzivorus*	bobolink	G5	S3B	N	N	Inc	Dec	SI-N	N	GI-Inc	N	N	N	SD	N	N	N	U	U	U	U	PS	Mod
Bird	*Empidonax traillii adastus*	(Great Basin) willow flycatcher	G5T5	S1S2	N	N	Inc	Dec	N	N	SI	Inc	N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Empidonax traillii brewsteri*	mountain willow flycatcher	G5T3T4	S2B	N	N	Inc	Dec	SI-N	N	N	SI	SI-N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Empidonax traillii extimus*	southwestern willow flycatcher	G5T1T2	S1B	N	N	Inc	Dec	N	SI	Inc	SI	N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Falco mexicanus*	prairie falcon	G5	S4	N	N	Inc	Dec	SD	N	SI-N	N	N	N	SI	N	N	N	U	U	U	U	PS	VH
Bird	*Falco peregrinus*	peregrine falcon	G4	S2	N	N	Inc	Dec	N-SD	N	SI	SI	N	N	SI	N	N	N	U	U	U	U	PS	Low
Bird	*Gavia immer*	common loon	G5	S2N	N	N	Inc	Dec	N	N	SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Grus canadensis tabida*	greater sandhill crane	G5T4	S2BS3M	N	N	Inc	Dec	N	N	SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Gymnorhinus cyanocephalus*	pinyon jay	G5	S3S4	N	N	N	Dec	N-SD	N	Inc	N	SI	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Haliaeetus leucocephalus*	bald eagle	G5	S1BS3N	N	N	Inc	Dec	N	N	N-SD	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Icterus parisorum*	Scott's oriole	G5	S4B	N	N	Inc	Dec	N-SD	N	Inc-SI	N	N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Ixbrychus exilis hesperis*	western least bittern	G5	S2	N	N	Inc	Dec	SI-N	N	GI	SI	SI-N	N	SD	SI	N	N	U	U	U	U	PS	Mod
Bird	*Lanius ludovicianus*	loggerhead shrike	G4	S4	N	N	SI	Dec	SD	N	SI	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Leucosticte atrata*	black rosy-finch	G4	S3	N	N	Inc	Dec	SI	GI	N	N	N	SI	SI	N	N	N	U	U	U	U	HV	VH
Bird	*Leucosticte tephrocotis*	gray-crowned rosy-finch	G5	S3N	N	N	Inc	Dec	Inc-SI	Inc	N	N	N	SI	SI	N	N	N	U	U	U	U	HV	VH
Bird	*Limnodromus scolopaceus*	long-billed dowitcher	G5	S4N	N	N	Inc	Dec	N	N	Inc-SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Melanerpes lewis*	Lewis's woodpecker	G4	S3	N	N	Inc	Dec	N	N	SI	SI	SD	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Numenius americanus*	long-billed curlew	G5	S2S3B	N	N	Inc	Dec	N	N	SI	Inc	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Oreortyx pictus*	mountain quail	G5	S3	N	N	N	Dec	N	N	SI	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Oreoscoptes montanus*	sage thrasher	G5	S5B	N	N	Inc	Dec	SD	N	Inc-SI	N	Inc	N	SD	GI-Inc	N	N	U	U	U	U	MV	Mod
Bird	*Otus flammeolus*	flammulated owl	G4	S4B	N	N	Inc	Dec	SI	N	SI-N	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Pelecanus erythrorhynchos*	American white pelican	G4	S2B	N	N	Inc	Dec	N	N	Inc	SI	N	N	SI	N	SI	N	U	U	U	U	MV	VH

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Bird	*Phalaropus lobatus*	red-necked phalarope	G4G5	S4M	N	N	Inc	Dec	N	N	Inc	SI	N	N	SI	N	N	N	U	U	U	U	MV	VH
Bird	*Phalaropus tricolor*	Wilson's phalarope	G5	S2S3BS4M	N	N	Inc	Dec	SI	N	Inc	Inc	N	N	SD	N	N	N	U	U	U	U	MV	VH
Bird	*Picoides albolarvatus*	white-headed woodpecker	G4	S2	N	N	N	Dec	N	N	N	N	Inc-SI	N	SD	N	N	N	U	U	U	U	PS	Low
Bird	*Plegadis chihi*	white-faced ibis	G5	S3B	N	N	Inc	Dec	N-SD	N	SI	SI	N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Rallus longirostris yumanensis*	Yuma clapper rail	G5T3	S1	N	N	N	Dec	N	N	GI	SI	N	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Recurvirostra americana*	American avocet	G5	S4B	N	N	Inc	Dec	N-SD	N	SI	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Riparia riparia*	bank swallow	G5	S3	N	N	Inc	Dec	N	N	Inc	SI	N	N	SI	N	N	N	U	U	U	U	MV	VH
Bird	*Selasphorus rufus*	rufous hummingbird	G5	S3M	N	N	Inc	Dec	SI	N	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Spizella atrogularis*	black-chinned sparrow	G5	S3B	N	N	Inc	Dec	N	N	Inc-SI	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Bird	*Spizella breweri*	Brewer's sparrow	G5	S4B	N	N	Inc	Dec	N-SD	N	SI	N	SI	N	SD	GI-Inc	N	N	U	U	U	U	MV	Mod
Bird	*Strix occidentalis occidentalis*	California spotted owl	G3	S1N	N	N	N	Inc	N	N	SI	N	Inc	N	SD	N	N	N	U	U	U	U	MV	VH
Bird	*Toxostoma bendirei*	Bendire's thrasher	G4G5	S1	N	N	Inc	Dec	N	N	Inc	N	SI	N	SD	SI	N	N	U	U	U	U	PS	VH
Bird	*Toxostoma lecontei*	LeConte's thrasher	G4	S2	N	N	Inc	Dec	SD	N	Inc	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Tympanuchus phasianellus columbianus*	Columbian sharp-tailed grouse	G4T3	S1	N	N	Inc	Dec	SD	N	SI	N	Inc	N	SD	N	N	N	U	Inc	U	U	MV	VH
Bird	*Vermivora virginiae*	Virginia's warbler	G5	S4B	N	N	Inc	Dec	Inc-SI	N	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Bird	*Vireo bellii arizonae*	Arizona Bell's vireo	G5T4	S2B	N	N	Inc	Dec	N	N	Inc	SI	N	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Aplodontia rufa californica*	aplodontia (mountain beaver)	G5T3T4	S1	Inc	N	N	SI	N	Inc-SI	N	Inc	SI	N	SD	N	N	N	U	U	U	U	HV	Low
Mammal	*Brachylagus idahoensis*	pygmy rabbit	G4	S3	N	N	SI	SD	SD	N	SI	N	Inc	N	SI-N	GI-Inc	Inc	N	U	U	U	U	EV	Mod
Mammal	*Chaetodipus penicillatus*	desert pocket mouse	G5	S1	N	N	Inc	N	N	N	GI-Inc	N	N	N	SI	N	N	N	U	U	U	U	MV	VH
Mammal	*Corynorhinus townsendii*	Townsend's big-eared bat	G4	S2	N	N	SI	Dec	SD	N	N	N	N	N	Inc	N	N	N	U	U	U	U	PS	VH
Mammal	*Dipodomys deserti*	desert kangaroo rat	G5	S2S3	N	N	Inc	N	SD	N	GI-Inc	N	N	N	SI-N	N	N	N	U	U	U	U	PS	VH
Mammal	*Euderma maculatum*	spotted bat	G4	S2	N	N	SI	Dec	SD	N	SI	N	N	N	SI	N	N	N	U	U	U	U	PS	VH
Mammal	*Glaucomys sabrinus*	northern flying squirrel	G5	S3	N	N	N	N-SD	N	N	N	N	Inc	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Idionycteris phyllotis*	Allen's big-eared bat	G3G4	S1	N	N	SI	SD-Dec	SI-N	N	SI-N	N	N	N	N	N	N	N	U	U	U	U	PS	VH
Mammal	*Lasionycteris noctivagans*	silver-haired bat	G5	S3	N	N	Inc	Dec	N	N	N	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH

NatureServe Climate Change Vulnerability Index (CCVI), Release 2.01

Assessment Results for the Nevada Species of Conservation Priority (SOCP) Abridged version, March 21, 2012

Group	Species	English Name	GRank	SRank	Natl barriers B2a	Anth barriers B2b	CC mitigation B3	Dispersal/Movement C1	historical thermal niche C2ai	physiological thermal niche C2aii	historical hydrological niche C2bi	physiological hydrological niche C2bii	Disturbance C2c	Ice/snow C2d	Phys habitat C3	Other spp for hab C4a	Diet C4b	Other spp disp C4d	Genetic var C5a	Gen bottleneck C5b	Phenol response C6	Doc response D1	Index	Conf.
Mammal	*Lasiurus blossevillii*	western red bat	G5	S1	N	N	SI	Dec	SD	N	GI-Inc	SI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Lasiurus cinereus*	hoary bat	G5	S3	N	N	Inc	Dec	SD	N	N	N	N	N	SD	N	N	N	U	U	U	U	IL	VH
Mammal	*Lemmiscus curtatus*	sagebrush vole	G5	S3	N	N	Inc	SD	SD	N	SI	N	Inc	N	N	GI-Inc	N	N	U	U	U	U	HV	VH
Mammal	*Lepus americanus tahoensis*	Sierra Nevada snowshoe hare	G5T3T4Q	S3	N	N	N	SD	N	N	N	SI-N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Lontra canadensis*	northern river otter	G5	S2	N	N	N	SD	N-SD	N	SI-N	Inc	SI	N	SD	GI-Inc	N	N	U	U	U	U	MV	Mod
Mammal	*Macrotus californicus*	California leaf-nosed bat	G4	S2	N	N	SI	Dec	N	N	GI	N	N	N	Inc	N	N	N	U	U	U	U	PS	VH
Mammal	*Martes americana*	American marten	G5	S2S3	N	N	N	SD	N	N	SI-N	N	Inc	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Microdipodops megacephalus*	dark kangaroo mouse	G4	S2	SI-N	SI-N	SI	N	N	N	Inc	N	Inc	N	SI	N	N	N	U	U	U	U	HV	Mod
Mammal	*Microdipodops pallidus*	pale kangaroo mouse	G3	S2	SI-N	SI	SI	N	SD	N	Inc	N	N	N	Inc	N	N	N	U	U	U	N	MV	VH
Mammal	*Microtus montanus fucosus*	Pahranagat Valley vole	G5T2	S2	SI-N	N	SI	N	N	N	Inc	SI	SI	N	SD	N	N	N	U	U	U	U	PS	Low
Mammal	*Myotis ciliolabrum*	western small-footed myotis	G5	S3	N	N	SI	Dec	SD	N	N	N	N	N	SI	N	N	N	U	U	U	U	PS	VH
Mammal	*Myotis evotis*	long-eared myotis	G5	S4	N	N	N	Dec	N-SD	N	SD	N	N	N	SD	N	N	N	U	U	U	U	IL	VH
Mammal	*Myotis lucifugus*	little brown bat	G5	S3	N	N	SI	Dec	N-SD	N	SI-N	N	N	N	SD	N	N	N	U	U	U	U	IL	Mod
Mammal	*Myotis thysanodes*	fringed myotis	G4G5	S2	N	N	SI	Dec	SD	N	SI	N	N	N	N	N	N	N	U	U	U	U	IL	VH
Mammal	*Myotis velifer*	cave myotis	G5	S1	N	N	SI	Dec	N	N	GI	N	N	N	Inc	N	N	N	U	U	U	U	PS	VH
Mammal	*Neotamias amoenus celeris*	Humboldt yellow-pine chipmunk	G5T2	S2	SI	N	N	N	N	N	Inc	N	N	N	SD	GI-Inc	N	N	U	U	U	U	MV	VH
Mammal	*Neotamias palmeri*	Palmer's chipmunk	G2	S2	GI	N	N	N	N	SI	SI	N	SI	N	SD	N	N	N	U	U	U	U	HV	VH
Mammal	*Neotamias senex*	Allen's chipmunk	G5	S2S3	SI	N	N	N	N	N	N-SD	N	Inc	N	SD	N	N	N	U	U	U	SI	PS	VH
Mammal	*Ochotona princeps*	American pika	G5	S2	GI	N	N	SD	N-SD	GI	SD	N	N	SI	Inc-SI	N	N	N	U	U	U	Inc-SI	MV	Mod
Mammal	*Odocoileus hemionus*	mule deer	G5	S5	N	SI	SI	Dec	SD	N	N	N	Inc	N	SD	N	SI	N	U	U	U	U	PS	VH
Mammal	*Ovis canadensis*	bighorn sheep	G4	S4	SI	SI	SI	Dec	N	N	N	N	N	N	SI	N	SI	N	U	U	U	U	MV	VH
Mammal	*Sorex merriami leucogenys*	Merriam's shrew	G5	S3	N	N	SI-N	N	SD	N	SI-N	N	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Sorex monticolus*	montane shrew	G5	S3	Inc	N	N	N	N	N	SI-N	Inc-SI	SI	N	SD	N	N	N	U	U	U	N-SD	MV	VH
Mammal	*Sorex palustris*	American water shrew	G5	S2	Inc	N	N	N	N-SD	N	SI-N	Inc	SI	N	SD	N	N	N	U	U	U	SI	MV	VH
Mammal	*Sorex preblei*	Preble's shrew	G4	S1	SI	N	N	N	SD	N	SI	N	N	N	SD	N	N	N	U	U	U	U	PS	VH

NatureServe Climate Change
Vulnerability Index (CCVI), Release 2.01

Assessment Results for the
Nevada Species of Conservation Priority (SOCP)
Abridged version, March 21, 2012

					Natl barriers	Anth barriers	CC mitigation	Dispersal/Movement	historical thermal niche	physiological thermal niche	historical hydrological niche	physiological hydrological niche	Disturbance	Ice/snow	Phys habitat	Other spp for hab	Diet	Other spp disp	Genetic var	Gen bottleneck	Phenol response	Doc response		
Group	**Species**	**English Name**	**GRank**	**SRank**	**B2a**	**B2b**	**B3**	**C1**	**C2ai**	**C2aii**	**C2bi**	**C2bii**	**C2c**	**C2d**	**C3**	**C4a**	**C4b**	**C4d**	**C5a**	**C5b**	**C6**	**D1**	**Index**	**Conf.**
Mammal	*Sorex tenellus*	Inyo shrew	G3G4	S2	SI	N	N	N	N	N	N	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Spermophilus elegans nevadensis*	Wyoming ground squirrel	G5T4	S4	N	N	N	N	N	N	SI-N	N	N	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Tadarida brasiliensis*	Brazilian free-tailed bat	G5	S3S4	N	N	Inc	Dec	SI-N	N	N	N	N	N	SI-N	N	N	N	U	U	U	U	PS	VH
Mammal	*Thomomys bottae*	pocket gopher	G5	SNR	SI	SI	Inc	SI-N	N-SD	N	Inc-SI	N	N	N	SD	N	N	N	U	U	U	U	MV	Mod
Mammal	*Thomomys monticola*	mountain pocket gopher	G5	S3	SI	N	N	N	N	N	N-SD	SI	SI	N	SD	N	N	N	U	U	U	U	PS	VH
Mammal	*Zapus princeps*	western jumping mouse	G5	S2	SI	N	N	N	N-SD	N	N-SD	Inc	SI	N	SD	N	N	N	U	U	U	SI	PS	Mod

Factor Scores:
GI - Greatly Increase Vulnerability
Inc - Increase Vulnerability
SI - Somewhat Increase Vulnerability
N - Neutral
SD - Somewhat Decrease Vulnerability
Dec - Decrease Vulnerability
U - Unknown

Color coding:
To highlight factors that influence climate change vulnerability.
Red - Greatest influence in increasing vulnerability
Orange - Moderate influence in increasing vulnerability
Green - Contributes to decrease in vulnerability

Index Scores:
EV - Extremely Vulnerable: Abundance and/or range extent within geographical area assessed extremely likely to substantially decrease or disappear by 2050.
HV - Highly Vulnerable: Abundance and/or range extent within geographical area assessed likely to decrease significantly by 2050.
MV - Moderately Vulnerable: Abundance and/or range extent within geographical area assessed likely to decrease by 2050.
PS - Not Vulnerable/Presumed Stable: Available evidence does not suggest that abundance and/or range extent within the geographical area assessed will change (increase/decrease) substantially by 2050. Actual range boundaries may change.
IL - Not Vulnerable/Increase Likely: Available evidence suggests that abundance and/or range extent within geographical area assessed is likely to increase by 2050.

Confidence (in species information):
VH - Very High confidence
High - High confidence
Mod - Moderate confidence
Low - Low confidence

APPENDIX E

BIRD POPULATION RESPONSES TO PROJECTED EFFECTS OF CLIMATE CHANGE IN NEVADA: ANALYSIS FOR REVISION OF THE NEVADA WILDLIFE ACTION PLAN

(GREAT BASIN BIRD OBSERVATORY, 2011)

Methods

Bird Data

For modeling landbird population change, we used data from the first ten years of the Nevada Bird Count (NBC) and from recent landbird inventory projects in Nevada that used the same point-count design as NBC for assessing bird populations. Our analyses in this report are restricted to those priority species of the Wildlife Action Plan that are diurnal landbirds with relatively small breeding territories, because point count surveys are designed to estimate densities for these species. Species with large home ranges, waterbirds, shorebirds, and secretive marshbirds are not included in our analyses, nor are landbird species that are so rare in Nevada that reasonable density estimates cannot be derived for their primary breeding habitats.

Nevada Bird Count

The Nevada Bird Count was conceptually developed by the Great Basin Bird Observatory (GBBO) in 2001-2002 and began to be implemented statewide in May 2002. It targets all landbirds of Nevada in a multi-species, habitat-stratified sampling design using primarily the point count method. Long-term trend monitoring was one objective of the program. A shorter-term objective was to generate habitat models for conservation priority species specifically to assist resource management agencies in their goal to manage habitats for bird conservation. This report is one such effort. Large-scale monitoring programs such as the Nevada Bird Count provide a wealth of information that can often be used for purposes not originally anticipated at the start of the program.

The original habitat stratification for the program used landcover types from the original GAP project (1990s), combined into 13 broad "habitat types" dominated by vegetation that correspond roughly with the Biophysical Settings used in the TNC climate change model (TNC 2011), including aspen (*Populus tremuloides*), montane riparian, lowland riparian, coniferous forest, pinyon-juniper (*Pinus* and *Juniperus* spp.), Mountain Mahogany (*Cercocarpus ledifolius*), sagebrush (*Artemisia* spp.), salt desert, Mojave scrub (including *Larrea tridentate* and *Ambrosia dumosa*), agricultural, and wetland. Random selection of NBC monitoring sites entailed a random point scatter generated for each habitat type using GIS, which served as a starting point of a 10-point survey transect. Minor adjustments were made to accommodate accessibility, and all 259 transects were surveyed at least once, and a subset multiple times, resulting in 5178 point surveys available for our analyses after 320 transects from other projects were added (see below).

Other Projects

The Great Basin Bird Observatory has conducted several projects around Nevada that provide additional point count data, doubling the sample size that was used in this report. Most of these involve random selection of transects within the region or habitat type being targeted. The sample of riparian surveys is especially enhanced by this. While these points were randomly selected within a project area, they do not, for the most part, represent point in the original statewide random point scatter, but they were included here, as they represent high-priority landscapes or habitat types around Nevada that would otherwise not have been captured in our models.

The special project sites included regions that have already been identified as important for bird monitoring, either because they support critical populations of birds, for example under Audubon's Important Bird Areas (IBA) program, or because they are undergoing changes in land management or habitat restoration affecting birds. Also, some habitat types are very restricted in Nevada or fall primarily on private lands, for example lowland riparian areas, which makes a GIS approach to random site selection difficult. In these cases, access was obtained first and random placement of the survey transect was done in the field within the boundaries of the accessible area.

Field Methods

Point count surveys are NBC's primary approach to data collection for breeding landbirds (after Ralph et al. 1993), and the same protocol was used for all other data used in this report. Survey routes consisted of habitat-based, mostly off-road walking transects of 10 survey points (300 m apart in open, expansive habitats; 250 m apart in forested, restricted habitats). During a count, all birds detected by visual or auditory cues were recorded. Each point count survey lasted 10 minutes. Most transects were visited once annually during the peak breeding season of most Nevada landbirds, from April 25 through June 30 (Mojave region) and May 25 – July 10 (Great Basin region), between dawn and 10:00 a.m. in fair weather conditions (no strong winds or heavy precipitation). Fly-over sightings and birds at distance greater than 100 m were not included in the analyses for this report. Further details about the survey protocol and sample data sheets can be obtained from the GBBO website (http://www.gbbo.org).

Current Map

We used two separate products provided by The Nature Conservancy (TNC 2011):

1) Statewide maps (GIS raster coverage) of potential vegetation types (Biophysical Settings, or BPS) and current vegetation classes within them (SCLASS), created from interpreted satellite or low-flying aircraft imagery.

2) Non-spatial forecast of the anticipated future condition (in 50 years) of ecological systems with climate change effects (and assumptions of minimal management), using refined computerized predictive state-and-transition ecological models.

The foundation of the mapping component was stratification of the landscape into BPSs, which represent potential vegetation types. More specifically, the BPS is the type of dominant vegetation that is expected in the physical environment under natural ecological conditions and disturbance regimes. These types were based on LANDFIRE, Southwestern Regional Gap Analysis Program, and other map sources (for more details, see TNC 2011). Within each BPS, there are several classes of current vegetation condition (SCLASS). These classes include typical successional stages of the "characteristic" natural vegetation, as well as several "uncharacteristic" classes. Uncharacteristic classes are outside of reference condition classes and are caused by anthropogenic disturbances (e.g., non-native annual grass invasion).

The raster of current conditions covers the entire state of Nevada, but only 13 of the 14 phytogeographic regions were included in the TNC modeling effort. The very small Sierra Nevada region, limited to the Carson Range under this mapping effort, was not explicitly modeled because it is small and contains many residential developments, and because TNC completed a separate assessment for the Northern Sierra Nevada reported elsewhere (Low et al. 2011).

The complex state-and-transition models included changes in disturbance regimes as well as simple effects of changes in temperature and precipitation. The following are components of the models that are likely to be particularly important to birds (from TNC 2011):

1) Increased dispersal of non-native species (annual grasses, forbs, and trees) caused by CO_2 fertilization of plant growth during wetter than average years

2) Higher tree mortality during longer growing season droughts

3) Longer period of low flows caused by earlier snowmelt

4) Greater flood variability due to greater frequency of rain-on-snow events, which may favor cottonwood and willow recruitment on currently regulated rivers and creeks

5) More frequent, larger fires in forested systems

6) Longer fire return intervals in shrubland systems due to increased drought frequency preventing fine fuel build up

7) Increased dispersal of pinyon and juniper into shrublands caused by CO_2 fertilization during wetter than average years

8) Greater conifer and deciduous tree species recruitment and growth in wetlands/riparian due to drought and CO_2 fertilization

9) Impaired recruitment of willow and cottonwood due to descending peak flows occurring one month earlier, and limited ability of these species to flower one month earlier in cold drainages

Some of these climate change hypotheses carry contradictory predictions, e.g., increased recruitment of trees vs. more frequent forest fires, which we assume that the overall climate model takes into account. For this report, we used the (unedited) model output from TNC (2011) to predict bird population change based only on habitat shifts and changes in habitat condition predicted by the TNC model.

Bird-Habitat Models

For modeling current bird habitat use, we used the raster map of current vegetation conditions from TNC (2011). The landbird data from the NBC and similar projects in Nevada were limited to a 100 m radius distance from each survey point, because detectability of most landbirds decreases rapidly beyond this distance. We then created a 100 m spatial buffer around each point, and calculated the percentages of each current vegetation cover type within that circle (3.14 ha).

Ideally, we would want to derive bird density estimates from points that are 100% covered by one BPS or SCLASS to make the purest estimate for each vegetation class. However, the majority of Nevada landscapes vary enough to make this impossible, particularly with our randomly selected transect locations. We therefore chose the lower threshold for the minimum area covered by one BPS or SCLASS of 25% (or 50% in more common and widespread vegetation classes). Some survey points were covered by multiple habitat types that met this minimum criterion, in which case they were used to represent each of these habitat types in our predictions.

We also largely eliminated survey points for upland vegetation classes that had riparian cover in the circle, except when the riparian habitat type was the one of interest in the analysis. In some habitat types, such as salt desert or sagebrush, areas near riparian or wetlands show differences in bird use than areas remote from mesic habitats (GBBO 2010). Therefore, if sample size was adequate for those upland habitat types we discarded the points with riparian cover within 100 m in order to get a more typical bird density estimation for the targeted habitat. For riparian habitat covers themselves, we used the 25% cover minimum for inclusion.

Inevitably, samples sizes varied among habitat types because of varying amounts of cover types in the landscape. Some rare cover types lacked survey points, and others had too few for analyses. These were either merged in with a similar type (see below) or discarded, if they were too different from other habitat types. Merging of BSPs and SCLASSes resulted in habitats (or habitat types, as they will be called hereafter) and was done using the following rules:

1) Cluster analyses on the point count data were used to combine the BSPs and SCLASSes that were similar from a bird community perspective.

2) Cover types were further merged based on similarity in vegetation structure and composition variables that are considered important to birds (based on WAP Team 2005, GBBO 2010).

3) Condition classes within a single BPS were merged more commonly than condition classes among BPSs, unless the different BPSs were closely related (e.g. different sagebrush types); in a few cases, a very rare BPS was combined with the most similar one that was more common.

4) We tried to get at least 50 survey points in each merged vegetation class, although lower sample sizes were accepted if a cover type was of high interest for climate change planning.

After merging vegetation classes, we recalculated the percent cover of each habitat type in the 100-m-radius buffers and gained some additional sampling points which now met the 25% minimum criterion. Finally, we estimated bird density for each priority landbird species in each habitat type. For this, we calculated the average number of individuals (excluding fly-over observations) detected within 10 minutes and 100 m by taking the mean of multiple visits to each point. These numbers were then averaged over all points assigned to a particular habitat type, and extrapolated to the average detectable density in 40 ha.

Because the main goal was to get the best density estimate for each habitat type (rather than to compare them), we used different minimum cover thresholds for habitat types depending on available sample sizes. We used points with at least 50% of the cover type and no riparian covers for the few cases where this still gave us over 50 survey points. If this sample size was not met, we used the 25% threshold with no riparian, and if the sample size was still low, then we used the 25% threshold with riparian habitat nearby.

A working estimate of statewide population size can then be estimated by multiplying the densities by the number of hectares currently in each habitat type, and summing over all habitat types in each of the 13 regions from the climate model, which can then be summed for the state. These population estimates were only generated for the purpose of estimating effect size of climate change and should thus not be used for other purposes, such as absolute population size estimation for the state. From these population estimates, we deleted estimates obtained for habitat types where a species cannot occur based on its known natural history, as we assume that detections at such survey points were due to the presence of preferred habitats. For some statewide habitat types, data for the Mojave region (which for the purpose of this report, included the Clover-Delamar region identified in TNC 2011) were separated from data for the Great Basin region, but most habitat types were largely restricted to one or the other. Species density estimates only included the regions in which the species is known to nest (Floyd et al. 2007).

Predictions of Climate Change Effects

We used current acreages and model projections for future acreages after 50 years of climate change for each condition class within biophysical settings (TNC 2011) to project expected changes in landbird populations. These predictions carry the same limitations and assumptions as do the predictions for vegetation change, and also assume that habitat change will dictate most changes in bird populations (but see above for cautionary comments).

Projections for bird population change were calculated separately for the 13 regions in Nevada used in this analysis (for details on these regions, see TNC 2011). For birds with statewide breeding distributions, we summed habitat acreages across regions for one statewide total. Southern Nevada species were analyzed using only those appropriate regions (usually Mojave and Clover-Delamar). Some condition classes were projected to change greatly due to climate change, but some of these changes were not available in the current map, either because these classes are currently rare or because the available GIS layers cannot delineate them. In these cases, we made qualitative judgments about expected effects on the birds that occupy the changing habitats that were not mapped.

Results

The distribution of bird-survey transects across the 13 phytogeographic regions of TNC (2011) generally reflect the relative sizes of the regions (Table 1). Exceptions included the Tonopah region due to inaccessible Department of Defense lands, and the Mojave region which was more thoroughly covered than other regions due to strong partner support in Clark County.

Table 1. Existing bird point-count transect coverage of 13 phtogeographic regions identified in TNC (2011).

Phytogeographic Region	NBC Transects
Black Rock Plateau	59
Mojave	136
Calcareous Ranges	125
Clover-Delamar	6
Elko	88
Eastern Sierra Nevada Ranges	40
Eureka	30
Humboldt Ranges	9
Lahontan Basin	20
Owyhee Desert	3

Sierra Nevada	16
Toiyabe	38
Tonopah	5
Walker Corridor	10

The following table lists the Biophysical Settings and Condition Classes for which we have at least some bird data, and the number of survey points with at least 25% of the 100-m-radius circle in that type. The last two columns then show the merged categories and the resulting sample sizes that then meet the 25% minimum criteria.

Table 2. Merged cover types and their new habitat-type names used in this report for habitat modeling. Listed are Biophysical Settings (BPS) and Condition Classes (SCLASS) numbers and names from TNC (2011), the number of bird survey points available for each cover type (cover types with no bird data are not included), the habitat types resulting from merging cover types, and the final number of bird survey points in the merged cover types that met the 25% minimum cover threshold. Sample sizes in habitat types may be higher than the sum of sample sizes in the original cover types, because in some cases, the merging resulted in additional survey points meeting the minimum cover threshold.

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1087	Creosotebush	1	A:early	137	Creosote, Early	137
1087	Creosotebush	2	B:late-closed	188	Creosote, Late	188
10821	Blackbrush mesic	1	A:early	28	Blackbrush, Early	146
10820	Blackbrush thermic	1	A:early	100		
10820	Blackbrush thermic	2	B:late-closed	363	Blackbrush-thermic, Late	363
10821	Blackbrush mesic	2	B:mid-closed	72	Blackbrush-mesic, Late	133
10821	Blackbrush mesic	3	C:late-closed	42		
10821	Blackbrush mesic	14	shrub-annual-per	7	Blackbrush, shrub/annual	9
10820	Blackbrush thermic	14	shrub-annual-per	1		
1081	Mixed Salt Desert	1	A:early	9	Salt Desert, Early	9
1081	Mixed Salt Desert	2	B:late-open	231	Salt Desert, Mid/Late	231
1081	Mixed Salt Desert	3	C:late-open	22	SD-Greasewood, Late	119
1153	Greasewood	2	B:late-closed	100		
1081	Mixed Salt Desert	10	annual grassland	14	Salt Desert, shrub/annual	86
1081	Mixed Salt Desert	14	shrub-annual-per	68		
1153	Greasewood	10	annual grassland	2	Greasewood, shrub/annual	92
1153	Greasewood	14	shrub-annual-per	89		
1125	Big SAGE Steppe	1	A:early	2	Sagebrush, Early	26
10801	Big SAGE upland	1	A:early	4		
1126	Montane SAGE Steppe	1	A:early	4		
10800	Wyoming Big SAGE	1	A:early	6		
1124	Low SAGE Steppe	1	A:early	0		
1079	Low-Black SAGE	1	A:early	6		
1079	Low-Black SAGE	2	B:mid-open	82	Low/Black Sage, Mid/Late	112

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1079	Low-Black SAGE	3	C:late-open	26		
1124	Low SAGE Steppe	3	C:late-closed	124	Low Sage, Mid/Late	173
1124	Low SAGE Steppe	2	B:mid-open	50		
10800	Wyoming Big SAGE	3	C:late-closed	130	WY Big Sage, Late	129
10801	Big SAGE upland	2	B:mid-open	15	Big Sage upland, Mid/Late	70
10801	Big SAGE upland	3	C:mid-closed	25		
10801	Big SAGE upland	4	D:late-open	22		
10800	Wyoming Big SAGE	2	B:mid-open	120	Big Sage, Mid-open	136
1125	Big SAGE Steppe	2	B:mid-open	14		
1125	Big SAGE Steppe	3	C:mid-closed	78	Big Sage, Mid-closed	78
1126	Montane SAGE Steppe	2	B:mid-open	62	Mtn Sage, Mid-open	62
1126	Montane SAGE Steppe	3	C:mid-closed	320	Mtn Sage, Mid-closed	318
1126	Montane SAGE Steppe	4	D:late-open	27	Mtn Sage, Late-open	27
1126	Montane SAGE Steppe	5	E:late-closed	82	Mtn Sage, Late-closed	82
1079	Low-Black SAGE	4	D:late-closed	47	Low/Big Sage, Late-closed	70
10801	Big SAGE upland	5	E:late-closed	22		
10800	Wyoming Big SAGE	14	shrub-annual-per	273	Big Sage, shrub/annual	360
10801	Big SAGE upland	14	shrub-annual-per	25		
10800	Wyoming Big SAGE	10	annual grassland	4	Sage, annual grass	9
1125	Big SAGE Steppe	10	annual grassland	0		
10801	Big SAGE upland	10	annual grassland	2		
1079	Low-Black SAGE	10	annual grassland	0		
10801	Big SAGE upland	8	depleted	35	Big Sage, depleted	35
1124	Low SAGE Steppe	8	depleted	4	Low Sage, depleted	105
1079	Low-Black SAGE	8	depleted	99		
1125	Big SAGE Steppe	14	shrub-annual-per	6	Sage, shrub/annual	52
1079	Low-Black SAGE	14	shrub-annual-per	45		
1126	Montane SAGE Steppe	14	shrub-annual-per	137	Mtn Sage, shrub/annual	137
1126	Montane SAGE Steppe	8	depleted	156	Mtn Sage, depleted	156
1126	Montane SAGE Steppe	10	annual grassland	46	Mtn Sage, annual grass	46
10800	Wyoming Big SAGE	9	tree-annual-grass	265	Big Sage, tree-encroach	272
10801	Big SAGE upland	13	tree-encroached	2		
10801	Big SAGE upland	9	tree-annual-grass	0	Mixed-Sage, tree-encroach	3
1126	Montane SAGE Steppe	13	tree-encroached	1		
1079	Low-Black SAGE	9	tree-annual-grass	3		
1124	Low SAGE Steppe	13	tree-encroached	2	Low Sage, tree-encroach	41
1079	Low-Black SAGE	13	tree-encroached	38		
1086	Mountain Shrub	1	A:early	1	Mountain Shrub/Chapparal	45
1086	Mountain Shrub	2	B:mid-open	0		
1086	Mountain Shrub	3	C:mid-closed	4		

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1086	Mountain Shrub	8	depleted	0		
1086	Mountain Shrub	13	tree-encroached	18		
1086	Mountain Shrub	14	shrub-annual-per	4		
1103	Chaparral	1	A:early	0		
1103	Chaparral	2	B:late-closed	8		
1103	Chaparral	14	shrub-annual-per	0		
1062	Mountain Mahogany	1	A:early	29	Mountain Mahogany	110
1062	Mountain Mahogany	2	B:mid-closed	10		
1062	Mountain Mahogany	3	C:mid-open	2		
1062	Mountain Mahogany	4	D:late-open	10		
1062	Mountain Mahogany	5	E:late-closed	20		
1062	Mountain Mahogany	9	tree-annual-grass	0		
1062	Mountain Mahogany	10	annual grassland	0		
1019	Pinyon-Juniper	1	A:early	12	Pinyon/Juniper, Early	83
1019	Pinyon-Juniper	2	B:mid-open	6		
1019	Pinyon-Juniper	3	C:mid-open	51		
1019	Pinyon-Juniper	4	D:late-open	166	Pinyon/Juniper, Late	200
1052	Mixed Conifer	1	A:early	0	Mixed Conifer/ Dry Pine	146
1052	Mixed Conifer	2	B:mid-closed	16		
1052	Mixed Conifer	3	C:mid-open	4		
1052	Mixed Conifer	4	D:late-open	0		
1052	Mixed Conifer	5	E:late-closed	20		
1054	Ponderosa Pine	1	A:early	0		
1054	Ponderosa Pine	2	B:mid-closed	1		
1054	Ponderosa Pine	3	C:mid-open	1		
1054	Ponderosa Pine	4	D:late-open	0		
1054	Ponderosa Pine	5	E:late-closed	28		
1031	Jeffery Pine	1	A:early	3		
1031	Jeffery Pine	2	B:mid-closed	60		
1031	Jeffery Pine	3	C:mid-open	19		
1031	Jeffery Pine	4	D:late-open	0		
1031	Jeffery Pine	5	E:late-closed	0		
1031	Jeffery Pine	10	annual grassland	0		
1032	Red Fir	1	A	7	Red Fir	57
1032	Red Fir	2	B	54		
1032	Red Fir	3	C	1		
1032	Red Fir	4	D	0		
1032	Red Fir	5	E	2		
1055	Spruce Fir	1	A:early	1	Spruce/ Fir	53
1055	Spruce Fir	2	B:mid-closed	9		

BPS	BPS Name	SCLASS	SCLASS Name	# Points	Habitat Type Name	# Points
1055	Spruce Fir	3	C:mid-open	12		
1055	Spruce Fir	4	D:late-closed	29		
1033	Subalpine Woodland	3	C	0		
1033	Subalpine Woodland	4	D	1		
1050	Lodgepole Pine	4	D	1		
1050	Lodgepole Pine	5	E	1		
1020	Limber-Bristlecone	1	A:early	4	Subalpine Pine	52
1020	Limber-Bristlecone	2	B:mid-open	14		
1020	Limber-Bristlecone	3	C:late-open	26		
11551	Washes	1	A:early	28	Washes	84
11551	Washes	2	B:mid-closed	28		
11551	Washes	3	C:late-closed	33	Washes, Late	33
11551	Washes	16	exotic forb	12		
11550	Warm Desert Riparian	1	A:early	32	Warm Desert Ripar, CHAR	76
11550	Warm Desert Riparian	2	B:mid-closed	7		
11550	Warm Desert Riparian	3	C:mid-open	16		
11550	Warm Desert Riparian	4	D:late-closed	3		
11550	Warm Desert Riparian	5	E:late-closed	0		
11550	Warm Desert Riparian	16	exotic forb	93	Warm Desert Ripar, exotic	93
1154	Montane Riparian	1	A:early	113	Montane Riparian, Early	112
1154	Montane Riparian	2	B:mid-open	70	Montane Riparian, Late	223
1154	Montane Riparian	3	C:late-closed	87		
1154	Montane Riparian	16	exotic forb	136	Montane Riparian, Exotic	136
1154	Montane Riparian	18	desertified	138	Montane Riparian,	136
1160	Subalpine Riparian	1	A:early	0	Subalpine Riparian	31
1160	Subalpine Riparian	2	B:mid-open	18		
1160	Subalpine Riparian	3	C:late-closed	1		
1160	Subalpine Riparian	16	exotic forb	1		
1011	Aspen Woodland	1	A:early	36	Aspen Woodland	151
1011	Aspen Woodland	2	B:mid-closed	23		
1011	Aspen Woodland	3	C:late-closed	6		
1011	Aspen Woodland	8	depleted	34		
1011	Aspen Woodland	4	D:late-open	42	Aspen Wood, Late	42
1061	Aspen-Mixed Conifer	1	A:early	1	Aspen Mixed-Conifer	20
1061	Aspen-Mixed Conifer	2	B:mid-closed	0		
1061	Aspen-Mixed Conifer	3	C:mid-closed	10		
1061	Aspen-Mixed Conifer	4	D:late-open	0		
1061	Aspen-Mixed Conifer	5	E:late-closed	67	Aspen Mixed-Con, Late	67

The current and future projected area coverage (in hectares) of each of the resulting 55 habitat types are listed in Table 3, calculated from the model of TNC (2011). with the initial and projected hectares (statewide), and the proportional change over the 50 year timeframe. The final three columns are the number of bird surveys points in each, according to the three filter options explored. The option in bold is the one selected for final analyses.

Table 3. **Merged vegetation categories used in this report** (from Table 2), with the total hectares under current conditions (statewide), and the projected number of hectares remaining after 50 years with a model including climate change and minimum management (average, reported to us by TNC). The proportion remaining after 50 years is calculated directly from the previous two columns (projected/initial). The final three columns are the number of bird surveys points with at least 25% of the 100-m buffer in that category (column 1), with at least 25% and no riparian in the other 75% (column 2), and with at least 50% and no riparian. The option in **bold** is the one selected for final analyses.

NAME	INITIAL HECTARES	PROJECTED 50 YR CC HECTARES	PROPORTION REMAINING 50 YR	POINTS 25%	POINTS 25% NO RIP	POINTS 50% NO RIP
Creosote, Early	310,088	52,677	0.17	137	121	**74**
Creosote, Late	592,274	699,389	1.18	188	165	**85**
Blackbrush, Early	753,132	618,218	0.82	146	138	**54**
Blackbrush-thermic, Late	99,566	128,585	1.29	363	337	**180**
Blackbrush-mesic, Late	975,869	804,681	0.82	133	**96**	31
Blackbrush, shrub/annual	61,612	280,329	4.55	9	**8**	3
Salt Desert, Early	152,214	478,492	3.14	9	8	**8**
Salt Desert, Mid/Late	2,555,571	1,690,351	0.66	231	126	**75**
SD-Greasewd, Late	1,763,477	1,730,951	0.98	119	**82**	47
Salt Desert, shrub/annual	1,358,474	1,758,856	1.29	86	**66**	31
Greasewood, shrub/annual	228,856	399,088	1.74	92	**79**	38
Sagebrush, Early	385,198	936,273	2.43	**26**	16	0
Low/Black Sage, Mid/Late	982,465	786,973	0.80	112	**86**	23
Low Sage, Mid/Late	527,249	438,122	0.83	173	99	**64**
WY Big Sage, Late	397,562	523,017	1.32	129	**65**	31
Big Sage upland, Mid/Late	776,199	660,058	0.85	70	**55**	11
Big Sage, Mid-open	851,357	457,022	0.54	136	**48**	26
Big Sage, Mid-closed	235,536	174,208	0.74	78	**51**	24
Mtn Sage, Mid-open	693,382	690,185	1.00	62	**52**	16
Mtn Sage, Mid-closed	2,093,449	1,106,313	0.53	318	289	**178**
Mtn Sage, Late-open	216,566	303,032	1.40	**27**	16	3
Mtn Sage, Late-closed	350,873	279,411	0.80	82	**51**	16
Low/Big Sage, Late-closed	276,391	286,545	1.04	70	**52**	12
Big Sage, shrub/annual	857,049	453,712	0.53	360	230	**101**
Sage, annual grass	330,785	1,071,553	3.24	**9**	7	1
Big Sage, depleted	154,232	148,548	0.96	**35**	18	5
Low Sage, depleted	679,390	595,727	0.88	105	**84**	38
Sage, shrub/annual	212,868	374,491	1.76	**52**	39	15
Mtn Sage, depleted	680,489	493,324	0.72	156	**96**	33
Mtn Sage, shrub/annual	597,771	484,980	0.81	137	84	**53**
Mtn Sage, annual grass	245,797	391,558	1.59	**46**	31	6

NAME	INITIAL HECTARES	PROJECTED 50 YR CC HECTARES	PROPORTION REMAINING 50 YR	POINTS 25%	POINTS 25% NO RIP	POINTS 50% NO RIP
Big Sage, tree-encroach	1,968,035	1,788,612	0.91	272	166	**58**
Mixed-Sage, tree-encroach			8.62	3	2	0
Low Sage, tree-encroach	387,293	354,119	0.91	**41**	35	13
Mountain Shrub/Chapparal	112,698	98,563	0.87	**45**	24	12
Mountain Mahogony	248,170	239,471	0.96	**110**	26	14
Pinyon/Juniper, Early	741,774	556,470	0.75	83	**57**	16
Pinyon/Juniper, Late	1,180,690	1,294,859	1.10	200	108	**67**
Mixed Conifer/ Dry Pine	76,482	80,036	1.05	146	**53**	43
Red Fir				**57**	35	34
Spruce/ Fir	27,024	28,956	1.07	**53**	32	16
Subalpine Pine	53,902	55,814	1.04	**52**	31	21
Washes	122,763	20,609	0.17	**84**	83	13
Washes, Late	16,226	137,753	8.49	**33**	33	3
Warm Desert Ripar, CHAR	66,215	370	0.01	**76**	76	37
Warm Desert Ripar, exotic	286	3,202	11.19	**93**	93	56
Montane Riparian, Early	72,173	22,679	0.31	**112**	112	44
Montane Riparian, Late	129,886	107,614	0.83	**223**	223	31
Montane Riparian, Exotic	115,384	152,829	1.32	**136**	136	57
Montane Riparian, Desertif	110,638	112,875	1.02	**136**	136	19
Subalpine Riparian	31,963	28,346	0.89	**31**	31	2
Aspen Woodland	96,138	142,896	1.49	**151**	151	47
Aspen Wood, Late	121,537	63,659	0.52	**42**	42	16
Aspen Mixed-Conifer	8,924	24,509	2.75	**20**	20	4
Aspen Mixed-Con, Late	64,317	40,615	0.63	**67**	67	25

APPENDIX F

2012 SPECIES OF CONSERVATION PRIORITY LISTS

Aquatic Species: Bivalves

Common Name	Scientific Name	SRank
California floater	*Anodonta californiensis*	S1

Aquatic Species: Gastropods

Common Name	Scientific Name	SRank
Amargosa tryonia	*Tryonia variegata*	S2
Antelope Valley pyrg	*Pyrgulopsis pellita*	S1
Ash Meadows pebblesnail	*Pyrgulopsis erythropoma*	S1
bifid duct pyrg	*Pyrgulopsis peculiaris*	S1
Big Warm Spring pyrg	*Pyrgulopsis papillata*	S1
Blue Point pyrg	*Pyrgulopsis coloradensis*	S1
Butterfield pyrg	*Pyrgulopsis lata*	S1
Camp Valley pyrg	*Pyrgulopsis montana*	S1
Corn Creek pyrg	*Pyrgulopsis fausta*	S1
Crystal Spring pyrg	*Pyrgulopsis crystalis*	S1
Distal-gland pyrg	*Pyrgulopsis nanus*	S1
Dixie Valley pyrg	*Pyrgulopsis dixensis*	S1
Duckwater pyrg	*Pyrgulopsis aloba*	S1
Duckwater Warm Springs pyrg	*Pyrgulopsis villacampae*	S1
Elko pyrg	*Pyrgulopsis leporina*	S1
elongate Cain Spring pyrg	*Pyrgulopsis augustae*	S1
elongate Mud Meadows pyrg	*Pyrgulopsis notidicola*	S1
elongate-gland pyrg	*Pyrgulopsis isolata*	S1
Emigrant pyrg	*Pyrgulopsis gracilis*	S1
Fairbanks pyrg	*Pyrgulopsis fairbanksensis*	S1
Flag pyrg	*Pyrgulopsis breviloba*	S1
flat-topped Steptoe pyrg	*Pyrgulopsis planulata*	S1
Fly Ranch pyrg	*Pyrgulopsis bruesi*	S1
grated tryonia	*Tryonia clathrata*	S2
Hardy pyrg	*Pyrgulopsis marcida*	S1
Hubbs pyrg	*Pyrgulopsis hubbsi*	S1

State Rank (SRank) Key

S1-Critically imperiled due to extreme rarity, imminent threats, and/or biological factors.
S2-Imperiled due to rarity and/or other demonstrable factors.
S3-Rare and local throughout its range, or with very restricted range, or otherwise vulnerable to extinction.
S4- Apparently secure, though frequently quite rare in parts of its range, especially at its periphery.
S5- Demonstrably secure, though frequently quite rare in parts of its range, especially at its periphery.
S#S#- Range of uncertainty in numeric rank (i.e., S1S2)

Common Name	Scientific Name	SRank
Humboldt pyrg	*Pyrgulopsis humboldtensis*	S1
Kings River pyrg	*Pyrgulopsis imperialis*	S1
Lake Valley pyrg	*Pyrgulopsis sublata*	S1
Landyes pyrg	*Pyrgulopsis landyei*	S1
large gland Carico pyrg	*Pyrgulopsis basiglans*	S1
Lockes pyrg	*Pyrgulopsis lockensis*	S1
longitudinal gland pyrg	*Pyrgulopsis anguina*	S1
median-gland Nevada pyrg	*Pyrgulopsis pisteri*	S1
minute tryonia	*Tryonia ericae*	S1
Moapa pebblesnail	*Pyrgulopsis avernalis*	S1S2
Moapa Valley pyrg	*Pyrgulopsis carinifera*	S1
monitor tryonia	*Tryonia monitorae*	S1
neritiform Steptoe Ranch pyrg	*Pyrgulopsis neritella*	S1
northern Soldier Meadow pyrg	*Pyrgulopsis militaris*	S1
northern Steptoe pyrg	*Pyrgulopsis serrata*	S1
northwest Bonneville pyrg	*Pyrgulopsis variegata*	S1
Oasis Valley pyrg	*Pyrgulopsis micrococcus*	S2
ovate Cain Spring pyrg	*Pyrgulopsis pictilis*	S1
Pahranagat pebblesnail	*Pyrgulopsis merriami*	S1
Pleasant Valley pyrg	*Pyrgulopsis aurata*	S1
Point of Rocks tryonia	*Tryonia elata*	S1
Pyramid Lake pebblesnail	*Fluminicola dalli*	SNR
Sadas pyrg	*Pyrgulopsis sadai*	S1S2
small gland Carico pyrg	*Pyrgulopsis bifurcata*	S1
smooth juga	*Juga interioris*	S1
southeast Nevada pyrg	*Pyrgulopsis turbatrix*	S2
southern Duckwater pyrg	*Pyrgulopsis anatina*	S1
southern Soldier Meadow pyrg	*Pyrgulopsis umbilicata*	S1
southern Steptoe pyrg	*Pyrgulopsis sulcata*	S1
sportinggoods tryonia	*Tryonia angulata*	S1
Spring Mountains pyrg	*Pyrgulopsis deaconi*	S1
squat Mud Meadows pyrg	*Pyrgulopsis limaria*	S1
Steptoe hydrobe	*Eremopyrgus eganensis*	S1
sterile basin pyrg	*Pyrgulopsis sterilis*	S1
sub-globose Steptoe Ranch pyrg	*Pyrgulopsis orbiculata*	S1
transverse gland pyrg	*Pyrgulopsis cruciglans*	S1
turban pebblesnail	*Fluminicola turbiniformis*	SNR
Twentyone Mile pyrg	*Pyrgulopsis millenaria*	S1
Upper Thousand Spring pyrg	*Pyrgulopsis hovinghi*	S1

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S4- Apparently secure, though frequently quite rare in parts of its range, especially at its periphery.
S5- Demonstrably secure, though frequently quite rare in parts of its range, especially at its periphery.
S#S#- Range of uncertainty in numeric rank (i.e., S1S2)

Common Name	Scientific Name	SRank
Vinyards pyrg	*Pyrgulopsis vinyardi*	S1
Virginia Mountains pebblesnail	*Fluminicola virginius*	S1
White River Valley pyrg	*Pyrgulopsis sathos*	S1
Wongs pyrg	*Pyrgulopsis wongi*	S1

State Rank (SRank) Key

S1-Critically imperiled due to extreme rarity, imminent threats, and/or biological factors.
S2-Imperiled due to rarity and/or other demonstrable factors.
S3-Rare and local throughout its range, or with very restricted range, or otherwise vulnerable to extinction.
S4- Apparently secure, though frequently quite rare in parts of its range, especially at its periphery.
S5- Demonstrably secure, though frequently quite rare in parts of its range, especially at its periphery.
S#S#- Range of uncertainty in numeric rank (i.e., S1S2)

Aquatic Species: Fishes

Common Name	Scientific Name	SRank
Alvord chub	*Gila alvordensis*	S2
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*	S2
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*	S1
Big Smoky Valley speckled dace	*Rhinichthys osculus lariversi*	S1
Big Smoky Valley tui chub	*Gila bicolor ssp. 8*	S1
Big Spring spinedace	*Lepidomeda mollispinis pratensis*	S1
bonytail chub	*Gila elegans*	S1
bull trout (Jarbidge River basin pop)	*Salvelinus confluentus pop. 4*	S1
Clover Valley speckled dace	*Rhinichthys osculus oligoporus*	S1
Cui-ui	*Chasmistes cujus*	S1
desert dace	*Eremichthys acros*	S1
Devils Hole pupfish	*Cyprinodon diabolis*	S1
Diamond Valley speckled dace	*Rhinichthys osculus ssp. 10*	SH
Fish Lake Valley tui chub	*Gila bicolor ssp. 4*	S1
flannelmouth sucker	*Catostomus latipinnis*	S1
Hiko White River springfish	*Crenichthys baileyi grandis*	S1
Independence Valley speckled dace	*Rhinichthys osculus lethoporus*	S1
Independence Valley tui chub	*Gila bicolor isolata*	S1
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	S3
Little Fish Lake Valley tui chub	*Gila bicolor ssp. 6*	S1
Meadow Valley speckled dace	*Rhinichthys osculus ssp. 11*	S2
Meadow Valley Wash desert sucker	*Catostomus clarkii ssp. 2*	S2
Moapa dace	*Moapa coriacea*	S1
Moapa speckled dace	*Rhinichthys osculus moapae*	S1
Moapa White River springfish	*Crenichthys baileyi moapae*	S2
Monitor Valley speckled dace	*Rhinichthys osculus ssp. 5*	S1
Moorman White River springfish	*Crenichthys baileyi thermophilus*	S1
mountain whitefish	*Prosopium williamsoni*	S3
Oasis Valley speckled dace	*Rhinichthys osculus ssp. 6*	S1
Pahranagat roundtail chub	*Gila robusta jordani*	S1
Pahranagat speckled dace	*Rhinichthys osculus velifer*	S1

Common Name	Scientific Name	SRank
Pahrump poolfish	*Empetrichthys latos latos*	S1
Preston White River springfish	*Crenichthys baileyi albivallis*	S1
Railroad Valley springfish	*Crenichthys nevadae*	S2
Railroad Valley tui chub	*Gila bicolor ssp. 7*	S1
razorback sucker	*Xyrauchen texanus*	S1
Relict dace	*Relictus solitaries*	S2
Sheldon tui chub	*Gila bicolor eurysoma*	S1
tui chub in Dixie Valley	*Gila bicolor ssp. 9*	S1
Virgin River chub	*Gila seminuda*	S1
Virgin River chub (Muddy River pop.)	*Gila seminuda* pop. 2	S1
Virgin River spinedace	*Lepidomeda mollispinis mollispinis*	S1
Wall Canyon sucker	*Catostomus sp. 1*	S1
Warm Springs Amargosa pupfish	*Cyprinodon nevadensis pectoralis*	S1
Warner Valley redband trout	*Oncorhynchus mykiss* pop. 4	S1
White River desert sucker	*Catostomus clarkii intermedius*	S1S2
White River speckled dace	*Rhinichthys osculus ssp.* 7	S2S3
White River spinedace	*Lepidomeda albivallis*	S1
White River springfish	*Crenichthys baileyi baileyi*	S1
woundfin	*Plagopterus argentissimus*	S1
Yellowstone cutthroat trout	*Oncorhynchus clarkii bouvieri*	S1

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Aquatic & Terrestrial: Amphibians

Common Name	Scientific Name	SRank
Amargosa toad	*Anaxyrus nelsoni*	S2
Arizona toad	*Anaxyrus microscaphus*	S2
Columbia spotted frog (Great Basin pop.)	*Rana luteiventris pop. 3*	S2S3
Great Basin spadefoot	*Spea intermontana*	S4
Great Plains toad	*Anaxyrus cognatus*	S2
northern leopard frog	*Lithobates pipiens*	S2S3
relict leopard frog	*Lithobates onca*	S1
Sierra Nevada yellow-legged frog	*Rana sierrae*	SH
western toad	*Anaxyrus boreas*	S4

Terrestrial: Reptiles

Common Name	Scientific Name	SRank
chuckwalla	*Sauromalus ater*	S3
desert horned lizard	*Phrynosoma platyrhinos*	S4

Common Name	Scientific Name	SRank
desert iguana	*Dipsosaurus dorsalis*	S3
desert night lizard	*Xantusia vigilis*	S4
desert tortoise (Mojave Desert pop.)	*Gopherus agassizii*	S2S3
Gila monster	*Heloderma suspectum*	S2
long-nosed leopard lizard	*Gambelia wislizenii*	S4
Great Basin collared lizard	*Crotaphytus bicinctores*	S4
greater short-horned lizard	*Phrynosoma hernandesi*	S3S4
northern rubber boa	*Charina bottae*	S3S4
northwestern pond turtle	*Actinemys marmorata marmorata*	S3
pygmy short-horned lizard	*Phrynosoma douglasii*	SNR
Panamint alligator lizard	*Elgaria panamintina*	SNA
ring-necked snake	*Diadophis punctatus*	S3
rosy boa	*Lichanura trivirgata*	SNR
Shasta alligator lizard	*Elgaria coerulea shastensis*	S1
sidewinder	*Crotalus cerastes*	S4
Sierra alligator lizard	*Elgaria coerulea palmeri*	S2S3
Sonoran mountain kingsnake	*Lampropeltis pyromelana*	S2
Smith's black-headed snake	*Tantilla hobartsmithi*	S4
spotted leaf-nosed snake	*Phyllorhynchus decurtatus*	S4
western banded gecko	*Coleonyx variegatus*	S4
western brush lizard	*Urosaurus graciosus*	S4
western red-tailed skink	*Plestiodon gilberti rubricaudatus*	S2S3
Mojave shovel-nosed snake	*Chionactis occipitalis*	S4
western threadsnake	*Rena humilis*	S4

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Terrestrial: Birds

Common Name	Scientific Name	SRank
American Avocet	*Recurvirostra americana*	S4B
American Bittern	*Botaurus lentiginosus*	S3B
American White Pelican	*Pelecanus erythrorhynchos*	S2B
Bald Eagle (Contiguous US Pop)	*Haliaeetus leucocephalus*	S1B,S3N
Bank Swallow	*Riparia riparia*	S3B
Bell's Vireo	*Vireo bellii*	S2B
Bendire's Thrasher	*Toxostoma bendirei*	S1
Black Rosy-Finch	*Leucosticte atrata*	S3
Black Tern	*Chlidonias niger*	S2S3B
Black-chinned Sparrow	*Spizella atrogularis*	S3B
Bobolink	*Dolichonyx oryzivorus*	S3B

Common Name	Scientific Name	SRank
Brewer's Sparrow	*Spizella breweri*	S4B
California Spotted Owl	*Strix occidentalis occidentalis*	S1N
Canvasback	*Aythya valisineria*	S3S4
Cassin's Finch	*Carpodacus cassinii*	S5
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	S1
Common Loon	*Gavia immer*	S2N
Common Nighthawk	*Chordeiles minor*	S5B
Dusky Grouse	*Dendragapus obscurus*	S3
Ferruginous Hawk	*Buteo regalis*	S2
Flammulated Owl	*Otus flammeolus*	S4B
Gilded Flicker	*Colaptes chrysoides*	S1
Golden Eagle	*Aquila chrysaetos*	S4
Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*	S3N
Great Basin Willow Flycatcher	*Empidonax traillii adastus*	S1S2
Greater Sage-Grouse	*Centrocercus urophasianus*	S3
Greater Sandhill Crane	*Grus canadensis tabida*	S2B,S3M
Le Conte's Thrasher	*Toxostoma lecontei*	S2
Lewis's Woodpecker	*Melanerpes lewis*	S3
Loggerhead Shrike	*Lanius ludovicianus*	S4
Long-billed Curlew	*Numenius americanus*	S2S3B
Long-billed Dowitcher	*Limnodromus scolopaceus*	S4N
Mountain Quail	*Oreortyx pictus*	S3
Northern Goshawk	*Accipiter gentilis*	S2
Northern Pintail	*Anas acuta*	S5
Olive-sided Flycatcher	*Contopus cooperi*	S2B
Peregrine Falcon	*Falco peregrinus*	S2
Pinyon Jay	*Gymnorhinus cyanocephalus*	S3S4
Prairie Falcon	*Falco mexicanus*	S4
Redhead	*Aythya americana*	S4B
Red-necked Phalarope	*Phalaropus lobatus*	S4M
Rufous Hummingbird	*Selasphorus rufus*	S3M
Sage Sparrow	*Amphispiza belli*	S4B,S4N
Sage Thrasher	*Oreoscoptes montanus*	S5B
Scott's Oriole	*Icterus parisorum*	S4B
Short-eared Owl	*Asio flammeus*	S4
Sierra Nevada Mountain Willow Flycatcher	*Empidonax traillii brewsteri*	S2B
Sooty Grouse	*Dendragapus fuliginosus*	SNR
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	S1B

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Common Name	Scientific Name	SRank
Tricolored Blackbird	*Agelaius tricolor*	S1B
Virginia's Warbler	*Vermivora virginiae*	S4B
Western Burrowing Owl	*Athene cunicularia hypugaea*	S3B
Western Least Bittern	*Ixobrychus exilis hesperis*	S2B
Western Sandpiper	*Calidris mauri*	S5M
Western Snowy Plover	*Charadrius alexandrinus nivosus*	S3B
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	S1B
White-faced Ibis	*Plegadis chihi*	S3B
White-headed Woodpecker	*Picoides albolarvatus*	S2
Wilson's Phalarope	*Phalaropus tricolor*	S2S3B,S4M
Yuma Clapper Rail	*Rallus longirostris yumanensis*	S1

Terrestrial: Mammals

Common Name	Scientific Name	SRank
Allen's big-eared bat	*Idionycteris phyllotis*	S1
American marten	*Martes americana*	S2S3
American pika	*Ochotona princeps*	S2
American water shrew	*Sorex palustris*	S2
bighorn sheep	*Ovis canadensis*	S4
Botta's pocket gopher	*Thomomys bottae*	SH
California leaf-nosed bat	*Macrotus californicus*	S2
cave myotis	*Myotis velifer*	S1
dark kangaroo mouse	*Microdipodops megacephalus*	S2
desert kangaroo rat	*Dipodomys deserti*	S2S3
desert pocket mouse	*Chaetodipus penicillatus*	S1S2
fringed myotis	*Myotis thysanodes*	S2
hoary bat	*Lasiurus cinereus*	S3
Humboldt yellow-pine chipmunk	*Neotamias amoenus celeris*	S2
Inyo shrew	*Sorex tenellus*	S2
little brown myotis	*Myotis lucifugus*	S3
long-eared myotis	*Myotis evotis*	S4
Merriam's shrew	*Sorex merriami*	S3
Mexican free-tailed bat	*Tadarida brasiliensis*	S3S4
Mono Basin mountain beaver	*Aplodontia rufa californica*	S1
montane shrew	*Sorex monticolus*	S3
mountain pocket gopher	*Thomomys monticola*	S3
mule deer	*Odocoileus hemionus*	S5
northern flying squirrel	*Glaucomys sabrinus*	S3

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S#S#- Range of uncertainty in numeric rank (i.e., S1S2)

Common Name	Scientific Name	SRank
northern river otter	*Lontra canadensis*	S2
Pahranagat Valley montane vole	*Microtus montanus fucosus*	S1S2
pale kangaroo mouse	*Microdipodops pallidus*	S2
Palmer's chipmunk	*Neotamias palmeri*	S2
Preble's shrew	*Sorex preblei*	S1S2
pygmy rabbit	*Brachylagus idahoensis*	S3
sagebrush vole	*Lemmiscus curtatus*	S3
shadow (Allen's) chipmunk	*Neotamias senex*	S2S3
Sierra Nevada snowshoe hare	*Lepus americanus tahoensis*	S3
silver-haired bat	*Lasionycteris noctivagans*	S3
spotted bat	*Euderma maculatum*	S2
Townsend's big-eared bat	*Corynorhinus townsendii*	S2
western jumping mouse	*Zapus princeps*	S2
western red bat	*Lasiurus blossevillii*	S1
western small-footed myotis	*Myotis ciliolabrum*	S3
Wyoming ground squirrel	*Spermophilus elegans nevadensis*	S4

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APPENDIX G

The WAP Conservation Landscape and Focal Areas

Focal areas were identified as discrete landscape units using the natural basin and range geography of the Nevada landscape. These units were prioritized using biodiversity and species richness measures based upon NDOW and NNHP observations and element occurrences for species of conservation priority. Focal areas were initially determined be those basin and range units that captured as least one documented occurrence of at least 90% of the species of conservation priority. Basin and range units were then added manually such that at least one occurrence of the remaining 10% of the species of conservation priority (e.g. localized, endemic populations) were represented. Landscape units were also added to include Audubon Important Bird Areas (2012), NNHP Scorecard sites (2006), significant spring landscapes (NNHP 2011), greater sage-grouse preliminary priority habitat (NDOW 2012), crucial mule deer habitat (NDOW 2009), and crucial bighorn sheep habitat (NDOW 2010) that were not already represented by the basin and range units with high biodiversity.

The resulting focal areas map (Figure 1) provides information about the location of biologically diverse areas in Nevada, highlights landscapes containing endemic species, and recognizes important areas identified in prior conservation planning efforts. The map does not provide a prioritization of individual landscapes but is intended as an informational resource for strategy development and implementation. Each key habitat strategy in the Nevada WAP includes a list of associated focal areas based upon the landscape assessment described above. The focal area analysis captured 75% of the habitat type, and then all sites that had greater than 1% of that habitat type present in the focal area were added. For example, in Alpine and Tundra, 75% of the habitat type is in the Ruby Mountains, Snake Range, Toquima Range, and the Toiyabe Range. The East Humboldt Range, Jarbidge Wilderness, Wassuk Range, and Independence Mountains were added as secondary focal areas. It should be noted that for some habitat types (e.g. aspen or alpine) that don't have a large geographic extent and are more localized, yet critical almost everywhere they occur, that conservation efforts should or could extend beyond this analysis/list.

Focal areas provide a general overview of key areas for fish and wildlife but by no means are intended to imply that conservation action should be restricted to these areas. Prioritization of key areas in the conservation landscape will be carried out by local working groups during WAP implementation. The focal areas provide a framework for evaluating Nevada's WAP in a statewide context to help determine the extent to which conservation actions identified in the 22 key habitat strategies are benefiting the WAP Species of Conservation Priority.

Table 1 is a listing of 120 Focal Areas in Nevada as shown in the focal areas map (Figure 1). Table 2 is a listing of focal areas by key habitat type. The focal area analysis included 75% of the habitat type, and then all sites that had greater than 1% of that habitat type present in the focal area were added.

ID	Focal Area Description						
1	Mosquito Mountains	31	Independence Valley	61	Cherry Creek Range	91	Wassuk Range
2	Coleman Valley	32	Independence Mountains	62	Egan Basin	92	Mud Spring drainage
3	Sheldon NWR	33	Owyhee River Area	63	Steptoe Valley	93	Walker Lake
4	Bog Hot Valley	34	Pie Creek drainage	64	Spring Valley	94	Fish Lake Valley
5	Craine Creek Drainage	35	Bone Mountains	65	Snake Range	95	Silver Peak Range
6	Pine Forest Range	36	Wild Horse Range	66	Snake Valley	96	Bullfrog Hills
7	Massacre Range	37	West Fork Beaver Creek	67	Hamilin Valley	97	Oasis Valley
8	Nut Mountain	38	Adobe Range	68	White Rock Mountains	98	Amargosa Desert
9	High Rock Area	39	Bruneau River	69	Little Smokey Valley	99	Pahrump Valley
10	Black Rock Range	40	The Islands	70	Hot Creek Valley	100	Indian Springs Valley
11	Little High Rock Mountains	41	Jarbidge Wilderness	71	Pancake Range	101	Spring Mountains
12	Calico Mountains (Pershing Co.)	42	O'Neil Basin	72	Railroad Valley	102	Las Vegas Valley
13	Black Rock Desert West	43	Marys River	73	White River Valley	103	McCullough Range
14	Crooks Lake and plateau	44	Snake Mountains	74	Cave Valley	104	New York Mountains
15	Hays Canyon Range	45	Salmon River Range	75	Shoshone Range	105	Piute Valley
16	Boulder Mountain	46	Salmon Falls Creek Area	76	Upper Reese River Valley	106	Pahranagat Valley
17	Wall Canyon	47	Thousand Springs Valley	77	Toiyabe Range	107	Lower Meadow Valley Wash
18	Lost Creek Hills	48	Bishop Creek	78	Big Smoky Valley	108	Moapa Valley West
19	Duck Flat	49	Windermere Hills	79	Simpson Park Mountains	109	Las Vegas Wash
20	Madelin Mesa	50	Shoshone Basin	80	Roberts Creek Mountains	110	Black Mesa
21	Buffalo Hills	51	Deadline Ridge	81	Kobeh Valley	111	El Dorado Mountains
22	Granite Range (Washoe Co.)	52	Goose Creek	82	Grimes Hills	112	Muddy Mountains
23	Trout Creek Mountains	53	Spruce Mountain	83	Monitor Valley	113	White Basin
24	Montana Mountains	54	Pequop Mountains	84	Toquima Range	114	Bitter Ridge
25	Santa Rosa Range	55	Goshute Mountains	85	Clan Alpine Mountains	115	Gale Hills
26	Calico Mountains (Humboldt Co.)	56	East Humboldt Range	86	Carson Sink	116	Bitter Spring Valley
27	Goat Corral Flat	57	Huntington Valley	87	Pyramid Lake Valley	117	Black Mountains
28	North Fork Little Humboldt River	58	Ruby Mountains	88	Carson Range	118	Lake Mead
29	Owyhee Desert (South Fork Owyhee drainage)	59	Ruby Valley	89	Truckee Meadows	119	Moapa Valley East
30	Tuscarora Mountains	60	Butte Valley South	90	Carson Valley	120	Virgin River Valley

Table 1. Listing of 120 Focal Areas in Nevada as shown in the following map (Figure 1).

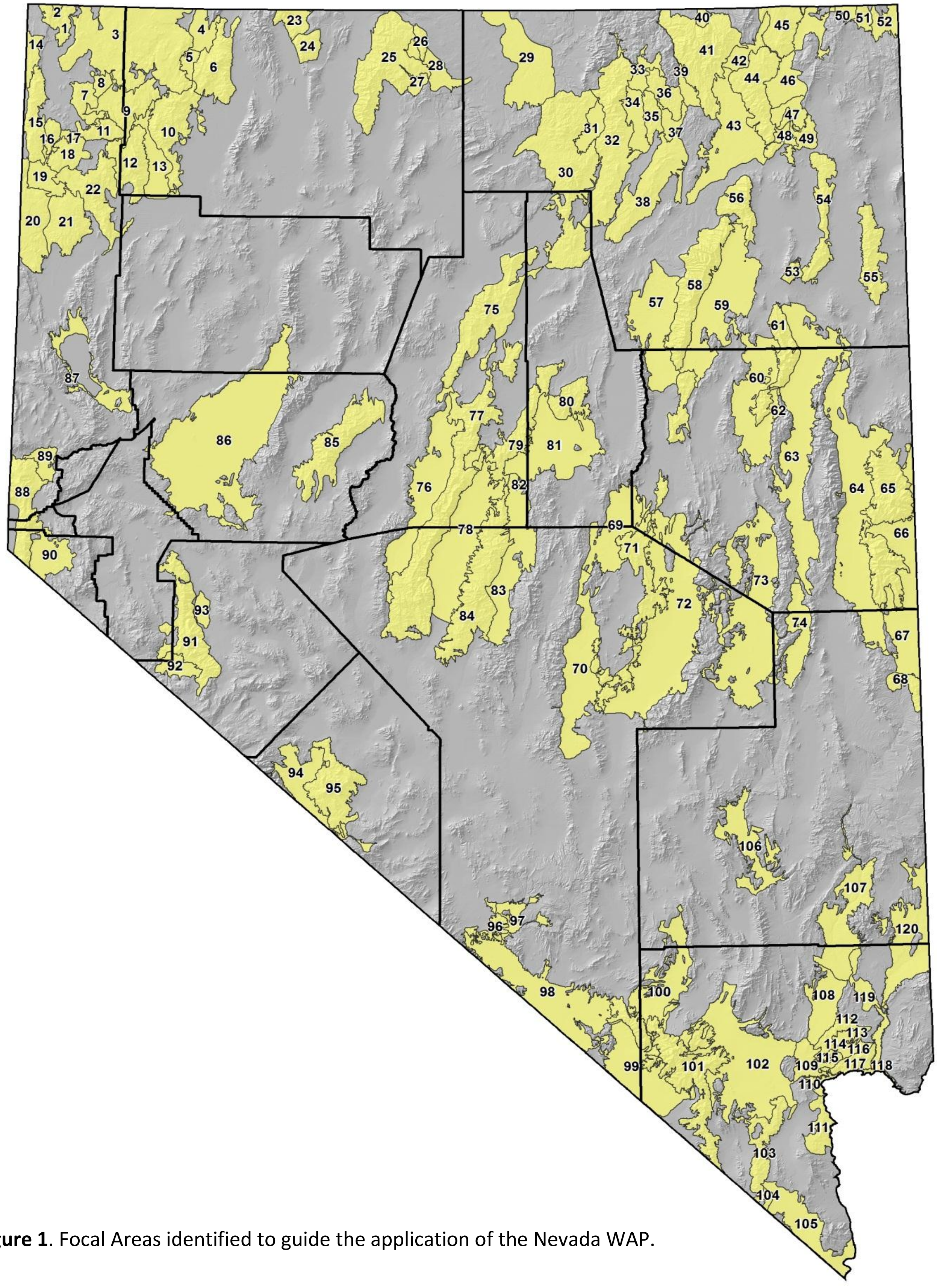

Figure 1. Focal Areas identified to guide the application of the Nevada WAP.

Table 2. Listing of Focal Areas by Habitat Type.

Intermountain Cold Desert Shrub	Amargosa Desert	Pahrump Valley
	Big Smoky Valley	Pancake Range
	Black Rock Desert	Pyramid Lake Valley
	Black Rock Desert West	Railroad Valley
	Black Rock Range	Ruby Valley
	Carson Sink	Silver Peak Range
	Fish Lake Valley	Snake Valley
	Hamilin Valley	Spring Valley
	Hot Creek Valley	Steptoe Valley
	Little Smokey Valley	Wassuk Range
	Pahranagat Valley	White River Valley
Mojave Warm Desert and Mixed Desert Shrub	Amargosa Desert	Moapa Valley-East
	Black Mountains	Muddy Mountains
	Bullfrog Hills	Oasis Valley
	El Dorado Mountains	Pahranagat Valley
	Indian Springs Valley	Pahrump Valley
	Las Vegas Valley	Piute Valley
	Las Vegas Wash	Spring Mountains
	Lower Meadow Valley Wash	Virgin River Valley
	McCullough Range	White Basin
	Moapa Valley -West	
Sagebrush	Adobe Range	Railroad Valley
	Buffalo Hills	Ruby Mountains
	Butte Valley	Ruby Valley
	Calico Mountains	Salmon Falls Creek Area
	Clan Alpine Mountains	Salmon River Range
	Granite Range	Santa Rosa Range
	Huntington Valley	Sheldon NWR
	Independence Mountains	Shoshone Range
	Jarbidge Wilderness	Simpson Park Mountains
	Kobeh Valley	Snake Mountains
	Little Smokey Valley	Spring Valley
	Madelin Mesa	Spruce Mountain
	Marys River Drainage	Steptoe Valley
	Monitor Valley	Toiyabe Range
	Owyhee Desert (South Fork Owyhee drainage)	Toquima Range
		Tuscarora Mountains
	Pancake Range	Upper Reese River Valley
Lower Montane Woodlands	Buffalo Hills	Santa Rosa Range

and Chaparral	Butte Valley Carson Range Cave Valley Cherry Creek Range Clan Alpine Mountains Crooks Lake and plateau Goshute Mountains Granite Range Hays Canyon Range Madelin Mesa Pancake Range Pequop Mountains Roberts Creek Mountains Ruby Mountains	Sheldon NWR Silver Peak Range Simpson Park Mountains Snake Range Snake Valley Spring Mountains Spring Valley Spruce Mountain Steptoe Valley Toiyabe Range Toquima Range Wassuk Range White River Valley White Rock Mountains
Intermountain Coniferous Forest and Woodlands	Cherry Creek Range East Humboldt Range Independence Mountains Jarbidge Wilderness Las Vegas Valley Ruby Mountains	Snake Range Spring Mountains Toiyabe Range Toquima Range Wassuk Range
Sierra Coniferous Forest and Woodlands	Carson Range	
Grasslands and Meadows	Adobe Range Black Rock Range Carson Sink East Humboldt Range Granite Range Hays Canyon Range Huntington Valley Independence Mountains Independence Valley Jarbidge Wilderness Mary's River Drainage Montana Mountains Owyhee Desert (South Fork Owyhee drainage) Pie Creek drainage	Pine Forest Range Railroad Valley Ruby Mountains Ruby Valley Santa Rosa Range Sheldon NWR Shoshone Range Simpson Park Mountains Snake Mountains Spring Valley Steptoe Valley Toiyabe Range Tuscarora Mountains Upper Reese River Valley White River Valley
Aspen Woodland	Black Rock Range Boulder Mountain East Humboldt Range Granite Range	Ruby Mountains Santa Rosa Range Sheldon NWR Snake Mountains

	Hays Canyon Range Independence Mountains Jarbidge Wilderness Pine Forest Range	Snake Range Toiyabe Range Tuscarora Mountains
Alpine and Tundra	East Humboldt Range Independence Mountains Jarbidge Wilderness Ruby Mountains	Snake Range Toiyabe Range Toquima Range Wassuk Range
Intermountain Rivers and Streams	Adobe Range Black Rock Desert Wash Bruneau River Carson Range Carson Sink Carson Valley East Humboldt Range Goose Creek Huntington Valley Independence Mountains Jarbidge Wilderness Mary's River Montana Mountains O'Neil Basin Owyhee Desert (South Fork Owhyee Drainage)	Owyhee River Area Pahranagat Valley Pyramid Lake Valley Railroad Valley Ruby Mountains Salmon Falls Creek Area Salmon River Range Santa Rosa Range Snake Mountains Truckee Meadows Tuscarora Mountains Walker River Wall Canyon Wassuk Range West Fork Beaver Creek White River Valley
Also:	Carson River Humboldt River and tributaries Jarbidge River and tributaries	Pyramid Lake Truckee River
Warm Desert Riparian	Amargosa Desert Bitter Spring Valley Bullfrog Hills Lake Mead Las Vegas Valley Las Vegas Wash	Lower Meadow Valley Wash Moapa Valley East Moapa Valley West Oasis Valley Virgin River Valley
Also:	Amargosa River Colorado River	Muddy River Virgin River
Springs and Springbrooks	Amargosa Desert Big Smoky Valley Black Rock Desert Wash	Monitor Valley Oasis Valley Pahranagat Valley

	El Dorado Mountain Fish Lake Valley Goshute Mountains Independence Valley Lower Meadow Valley Wash Moapa Valley East	Railroad Valley Roberts Creek Mountains Spring Mountains Spring Valley White River Valley
Also:	Condor Canyon	
Mesquite Bosques and Desert Washes and Desert Washes	Amargosa Desert Bitter Spring Valley Las Vegas Valley Las Vegas Wash	Lower Meadow Valley Wash Moapa Valley Virgin River Valley
Marshes	Amargosa Desert Carson Range Carson Sink Carson Valley Granite Range Pahranagat Valley	Pyramid Lake Valley Ruby Valley Sheldon NWR Spring Valley Steptoe Valley White River Valley
Lakes and Reservoirs	Carson Range Carson Sink Crooks Lake and plateau Lake Mead Owyhee River Area	Piute Valley Pyramid Lake Valley Ruby Valley Sheldon NWR Walker Lake
Desert Playas and Ephemeral Pools	Amargosa Desert Big Smoky Valley Black Rock Desert West Bog Hot Valley Carson Sink Fish Lake Valley	Indian Springs Valley Las Vegas Valley Railroad Valley Sheldon NWR Spring Valley
Sand Dunes and Badlands	Amargosa Desert Bitter Spring Valley Black Mesa Black Mountains Carson Sink Hays Canyon Range Las Vegas Valley	Las Vegas Wash Lower Meadow Valley Wash Moapa Valley - East Moapa Valley - West Pine Forest Range Piute Valley Virgin River Valley
Cliffs and Canyons	Black Mountains Black Rock Range Buffalo Hills	Pancake Range Pine Forest Range Ruby Mountains

	Calico Mountains-Pershing El Dorado Mountains Granite Range Hays Canyon Range High Rock Area Independence Mountains Jarbidge Wilderness Las Vegas Valley Madelin Mesa McCullough Range Montana Mountains Muddy Mountains	Santa Rosa Range Sheldon NWR Shoshone Range Silver Peak Range Snake Mountains Snake Range Spring Mountains Toiyabe Range Trout Creek Mountains Tuscarora Mountains Virgin River Valley Wassuk Range
Developed Landscapes	Carson Range Carson Sink Carson Valley Las Vegas Valley	Pahrump Valley Truckee Meadows Virgin River Valley
Barren Landscapes	Big Smoky Valley - North Black Rock Range Buffalo Hills Butte Valley - South Carson Sink Cherry Creek Range Clan Alpine Mountains Fish Lake Valley Huntington Valley Independence Mountains Madelin Mesa Mud Spring drainage	Pahrump Valley Roberts Creek Mountains Ruby Mountains Ruby Valley Santa Rosa Range Sheldon NWR Shoshone Range Spring Mountains Toiyabe Range Toquima Range Tuscarora Mountains White River Valley
Agricultural Lands	Amargosa Desert Big Smoky Valley - North Carson Sink Carson Valley Fish Lake Valley Marys River Drainage Moapa Valley - East Pahrump Valley Ruby Valley	Salmon Falls Creek Area Snake Valley Spring Valley Steptoe Valley Truckee Meadows Upper Reese River Valley Virgin River Valley White River Valley

APPENDIX H

MISCELLANEOUS MAPS

Greater Sage-Grouse Habitat Characterization Map

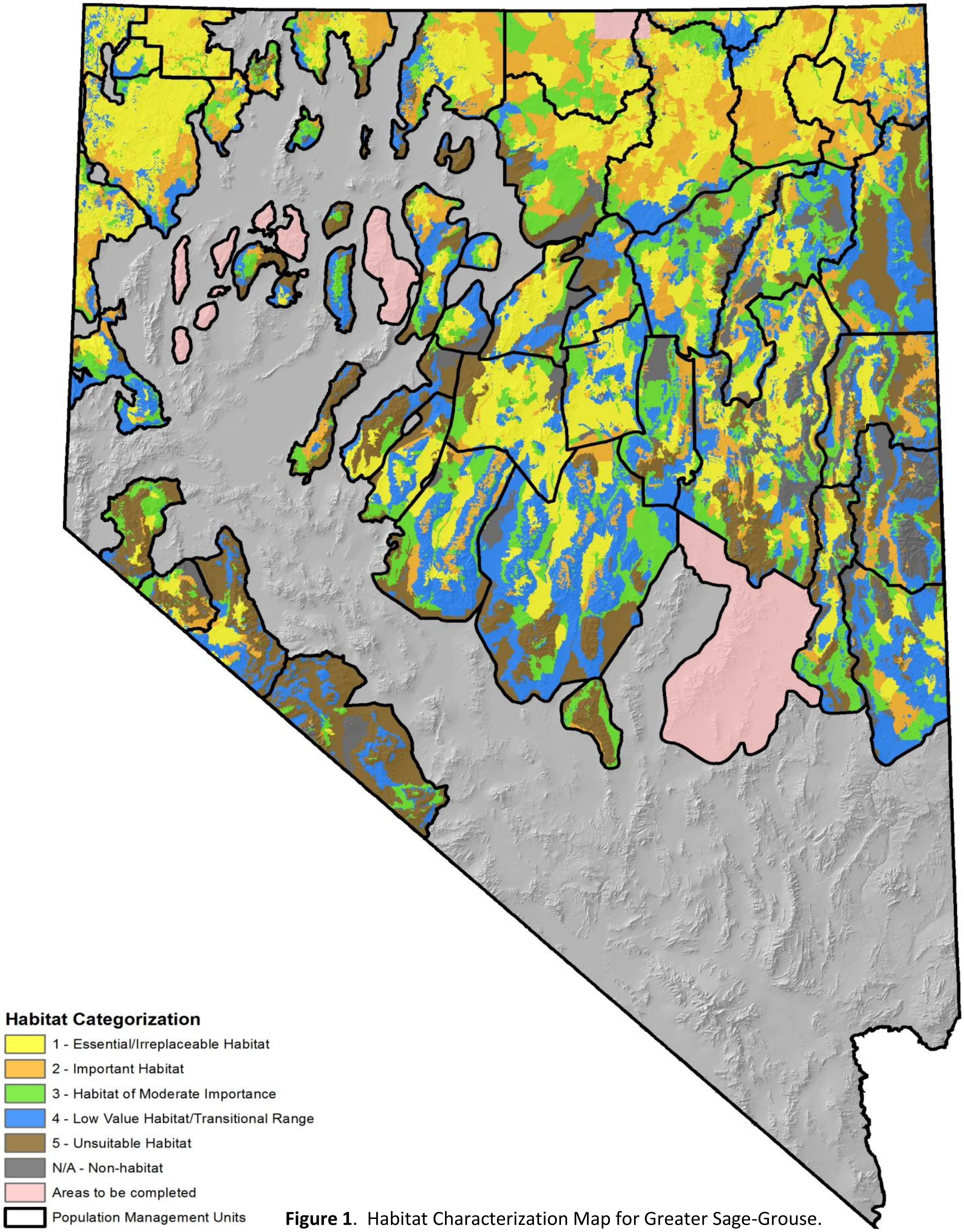

Figure 1. Habitat Characterization Map for Greater Sage-Grouse.

Audubon Important Bird Areas of Nevada

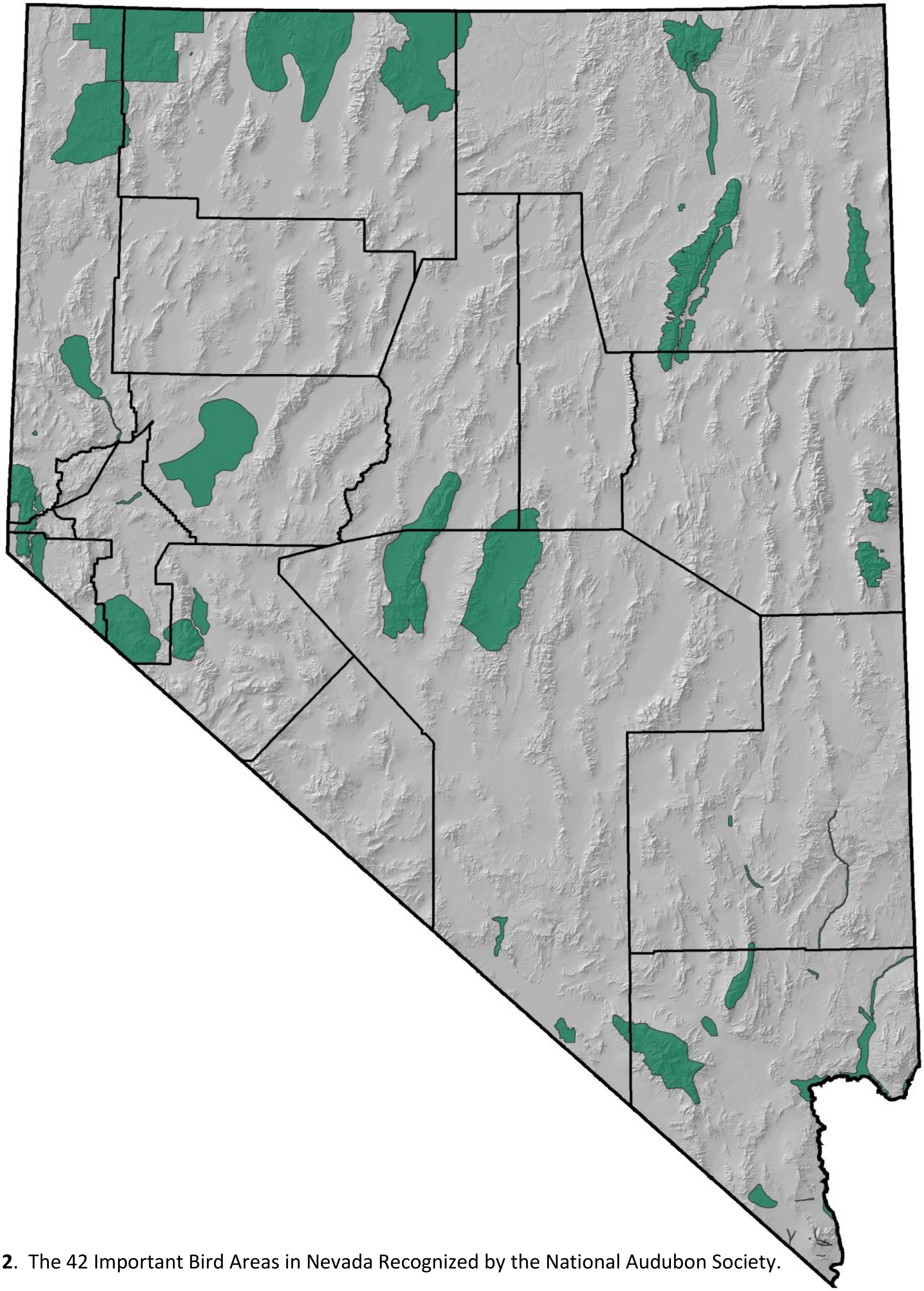

Figure 2. The 42 Important Bird Areas in Nevada Recognized by the National Audubon Society.

APPENDIX I

NON-NATIVE, INVASIVE ANIMAL SPECIES LIST

The following tables illustrate the non-native, invasive animal species documented in Nevada or suspected to exist due to populations in neighboring states. The list is split into aquatic and terrestrial categories and captures molluscs, fishes, amphibians, insects, birds, and mammals. The list also includes life history information on the individual species and the level of threat to native species and systems (High, Medium, Low) based on literature review.

Aquatic-Molluscs

Common Name	Species	Characteristics	Threat
quagga/zebra mussels	*Dreissena spp. (All)*	Highly prolific ; spatial and forage competitor, biofouling of agriculture and industrial infrastructure; Quagga more cold tolerant than zebra.	High
New Zealand mud snail	*Potamopyrgus antipodarum* *Potamopyrgus jenkinsi*	Highly prolific and tolerant of all water types. Displaces native invertebrates and aquatic forage resources.	High
African giant mud snail	*Achatina fulica*	Damages native plants and crops	Low
golden mussel	*Limnoperna fotunei*	Highly prolific, broad water quality tolerance, biofouling risks	High
Asian clam	*Corbicula fluminea*	Highly prolific and produces large colonies that can obstruct waterways	High
apple snails	*Marisa spp., Pila spp.* and *Pomacea spp. (All)*	Found in slow moving water; damages native plants	Low

Aquatic-Fishes

Common Name	Species	Characteristics	Threat
northern pike	*Esox lucius*	Highly piscivorous and aggressive	High
snakehead	*Ophicephalus spp.* & *Channa spp.* (All)	Preys on native species	Medium
gars	Family Lepisosteidae (All spp.)	Highly predatory	Low
South American Parasitic catfish	Families Cetoposidae and Trichomycteridae (All spp.)	Parasitizes fish, mammals and humans	Low
tiger (wolf) fish	*Hoplias malabaricus*	Highly predatory & aggressive	Low
nile perch	*Lates spp.* & *Luciolates spp.* (All)	Highly predatory & aggressive	Medium
Asian swamp eel	*Monopterus albus*	Competes with native species	Low
tilapia	*Tilapia spp., Oreochromis spp. & Sarotherodon spp. (All)*	Prefers warm waters; increases water turbidity by digging and impacting native plants	High
fathead minnow	*Pimephales promelas*	Tolerant of low oxygen, high turbid waters; highly prolific	Low
red shiner	*Cyprinella lutrensis*	Competitive; predatory on native fish eggs and early life stages	High
common carp	*Cyprinus carpio*	Highly predatory & competitive	Medium
bighead carp	*Hypophthalmichthys nobilis*	Highly predatory & competitive	Medium
black (snail) carp	*Mylopharyngodon pisceus*	Highly predatory & competitive	Medium

crucian carp	*Carassius carassius*	Highly predatory & competitive	Medium
Indian carp	*Catla catla, Cirrhina mrigala* & *Labeo rohita*	Highly predatory & competitive	Medium
silver carp	*Hypophthalmichthys molitrix*	Highly predatory & competitive	Medium
convict cichlid	*Amatitlania nigrofasciata*	Highly aggressive & predatory	Medium
gizzard shad	*Dorosoma cepedianum*	Highly prolific; can alter aquatic ecology	Low
sailfin molly	*Poecilia latipinna*	Tolerates low oxygen; Competes with native fish	Medium
guppy	*Poecilia reticulata*	Highly prolific & competes with native fish	Medium
western mosquitofish	*Gambusia affinis*	Highly prolific & competes with native fish	Medium

Aquatic-Amphibians

Common Name	Species	Characteristics	Threat
African Clawed Frog	*Xenopus spp.* (All)	Highly adaptable & predatory	Medium
bullfrog	*Rana catesbeiana*	Highly competitive & preys on native species; vector for amphibian diseases (e.g. Chrytrid fungus)	Medium

Aquatic-Arthropods

Common Name	Species	Characteristics	Threat
crayfish	Families Parastacidae, Ambaridae & Astacidae, (all spp.) except indigenous species of the genus *Pacifastacus*	Opportunistic feeder and aggressive competitor	Medium-High

Terrestrial-Birds

Common Name	Species	Characteristics	Threat
Eurasian Collared Dove	*Streptopelia decaocto*	Tolerant to human disturbance	Low
European Starling	*Sturnus vulgaris*	Competitive cavity nesters; tolerant to human disturbance	High
House Sparrow	*Passer domesticus*	Highly prolific and tolerant to human disturbance	Low

Terrestrial-Mammals

Common Name	Species	Characteristics	Threat
norway rat	*Rattus norvegicus*	Highly prolific; destructive; predatory	Low
black rat	*Rattus rattus*	Highly prolific & competitive	Low
house mouse	*Mus musculus*	Highly prolific; destructive	Low

APPENDIX J

NATIVE & INVASIVE PLANT LIST

The following tables capture the referenced plants, native and invasive species, found throughout this document. The Wildlife Action Plan Team elected to only use common names for plants to improve the readability, particular for the general reader. However, common names can create confusion for a variety of reasons. Common names can change from region-to-region; one common name can refer to more than one species; and common names have a way of changing over time. For example, there are two widespread species of greasewood in Nevada, and numerous species of sagebrush. In everyday conversation generic common names usually work well. But if you are considering management activities, landscape restoration or the habitat needs of a particular wildlife species, the need to differentiate between plant species and even subspecies suddenly takes on critical importance. This appendix provides the reader with a cross reference between the common plant names used in this document's text, and the scientific names that link common names to the precise species to which writers referenced.

With regards to invasive plants, all species listed under the Nevada Revised Statute 555 (NRS 555) as a "Noxious Weed" will be notated, within the larger table, as such. A noxious weed is a plant that has been designated by the state as a "species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate" (NRS 555.05). To assist the reader, we also included a separate table detailing the noxious weeds, category level (A, B, or C), and the typical habitats that these species invade.

Common Name Arranged Alphabetically

Common Name	Scientific Name	Status (E=Exotic; I=Invasive; N=Noxious)
acacia, catclaw	*Acacia greggii*	
agave	*Agave* spp.	
alder, mountain	*Alnus incana*	
alder, white	*Alnus rhombifolia*	
alder sp.	*Alnus* spp.	
arrowhead	*Sagittaria cuneata*	
arrowweed	*Pluchea sericea*	
ash, velvet	*Fraxinus velutina*	
aspen	*Populus tremuloides*	
aspen, quaking	*Populus tremuloides*	
aster	*Aster* spp.	
avens, alpine	*Geum rossii*	
balsamroot, arrowleaf	*Balsamorhiza sagittata*	
barberry, creeping	*Berberis repens*	
beeflower	*Cleome serrulata*	
birch	*Betula* spp.	
birch, water	*Betula occidentalis*	
bitterbrush, antelope	*Purshia tridentata*	
bitterbrush	*Purshia tridentata*	
bittercherry	*Prunus emarginata*	

blackbrush	*Coleogyne ramosissima*	
bluegrass	*Poa* spp.	
borax-weed, western	*Nitrophila occidentalis*	
boxthorn	*Lycium* spp.	
brome, red	*Bromus madritensis* var. *rubens*	
buckbrush	*Ceanothus velutinus*	
buckwheat, California	*Eriogonum fasciculatum*	
buckthorn	*Rhamnus* spp.	
budsage	*Artemisia spinescens*	
buffaloberry	*Shepherdia argentea*	
bulrush	*Scirpus* spp.	
bulrush, alkali	*Scirpus maritimus*	
bulrush, hardstem	*Scirpus acutus*	
burreed	*Sparganium* spp.	
bursage, white	*Ambrosia dumosa*	
cactus, beavertail	*Opuntia basilaris*	
camassia	*Camassia quamash*	
cattail	*Typha* spp.	
ceanothus, cup-leaf	*Ceanothus greggii* var. *vestitus*	
ceanothus	*Ceanothus* spp.	
cedar, incense	*Calocedrus decurrens*	
celery, wild	*Apium graveolens*	E
chamise	*Adenostoma* spp.	
cheatgrass	*Bromus tectorum*	E, I
chinquapin	*Chrysolepis sempervirens*	
chokecherry	*Prunus virginiana*	
cholla, buckhorn	*Opuntia acanthocarpa*	
cholla	*Opuntia* spp.	
chuparosa	*Justica californica*	
cicely, Western sweet	*Osmorhiza occidentalis*	
cinquefoil	*Potentilla* spp.	
cinquefoil, shrubby	*Pentaphylloides fruticosa*	
cliffrose	*Purshia stansburiana*	
columbine	*Aquilegia* spp.	
cottonwood, black	*Populus trichocarpa*	
cottonwood, Fremont	*Populus deltoides* var. *fremontii*	
creosote bush	*Larrea tridentata*	
currant	*Ribes* spp.	
currant, golden	*Ribes aureum*	
currant, Sierra	*Ribes nevadense*	
currant, squaw	*Ribes cereum*	
dalea	*Psorothamnus* spp.	
desert holly	*Atriplex hymenelytra*	
desert-thorn	*Lycium* spp.	
didymo	*Didymosphenia geminata*	I
dogwood	*Cornus* spp.	
dogwood, red-osier	*Cornus sericea*	
dropseed, sand	*Sporobolus cryptandrus*	

elder	*Sambucus* spp.	
elderberry, red	*Sambucus racemosa*	
elodea, Brazilian	*Egeria densa*	E, I
fern, bracken	*Pteridium aquilinum*	
fescue, Idaho	*Festuca idahoensis*	
fir, Douglas	*Pseudotsuga menziesii*	
fir, red	*Abies magnifica*	
fir, subalpine	*Abies lasiocarpa*	
fir, white	*Abies concolor*	
fireweed	*Chamerion* spp.	
flatsedge	*Cyperus* spp.	
galleta	*Pleuraphis jamesii*	
geranium, sticky	*Geranium viscosissimum*	
gilia, scarlet	*Ipomopsis aggregata*	
globemallow	*Sphaeralcea* spp.	
gooseberry, mountain	*Ribes roezlii*	
grama, blue	*Bouteloua gracilis*	
grass, needle-and-thread	*Hesperostipa comata*	
greasewood	*Sarcobatus vermiculatus*	
hackberry	*Celtis reticulata*	
hairgrass, slender	*Deschampsia elongata*	
hairgrass, tufted	*Deschampsia cespitosa*	
halogeton	*Halogeton glomeratus*	E, I
heath	*Erica* spp.	E
hellebore, false	*Veratrum californicum*	
hemlock, mountain	*Tsuga mertensiana*	
holly, desert	*Atriplex hymenelytra*	
honeysuckle	*Lonicera* spp.	
hopsage	*Grayia spinosa*	
horsebrush, four-part	*Tetradymia tetrameres*	
horsemint	*Monardella* spp.	
iodinebush	*Allenrolfea occidentalis*	
Joshua tree	*Yucca brevifolia*	
juniper, California	*Juniperus californica*	
juniper, common	*Juniperus communis*	
juniper, Utah	*Juniperus osteosperma*	
juniper, Rocky Mountain	*Juniperus scopulorum*	
juniper, western	*Juniperus occidentalis*	
larkspur	*Delphinium* spp.	
lavender, desert	*Hyptis emoryi*	
lily	*Lilium* spp.	
lily, water	*Nymphaea* spp.	
liveoak, shrub	*Quercus turbinella*	
lupine	*Lupinus* spp.	
lycium	*Lycium* spp.	
manzanita	*Arctostaphylos* spp.	
manzanita, greenleaf	*Arctostaphylos patula*	
manzanita, Mexican	*Arctostaphylos pungens*	

maple, bigtooth	*Acer macrophyllum*	
meadowrue, Fendler	*Thalictrum fendleri*	
medusahead	*Taeniatherum caput-medusae*	E, I, N
mesquite, honey	*Prosopis glandulosa*	
mesquite, screwbean	*Prosopis pubescens*	
mistletoe	*Phoradendron* spp.	
mistletoe, desert	*Phoradendron californicum*	
Mormon tea	*Ephedra* spp.	
mountain-mahogany	*Cercocarpus* spp.	
mountain-mahogany, alderleaf	*Cercocarpus. montanus*	
mountain-mahogany, curlleaf	*Cercocarpus ledifolius*	
mountain-mahogany, littleleaf	*Cercocarpus intricatus*	
mule's ears, mountain	*Wyethia mollis*	
mule's ears, northern	*Wyethia amplexicaulis*	
mustard, sahara	*Brassica tournefortii*	E, I, N
mustard, tansy	*Descurainia* spp.	E, I
needle-and-thread	*Hesperostipa comata*	
needlegrass, Western	*Achnatherum occidentalis*	
oak, black	*Quercus kelloggii*	
oak, Gambel's	*Quercus gambelli*	
oak, scrub	*Quercus* spp.	
oak, shrub live	*Quercus turbinella*	
ocotillo	*Fouquieria splendens* spp. s*plendens*	
olive, Russian	*Elaeagnus angustifolius*	E, I
paintbrush, Indian	*Castilleja* spp.	
palm, California fan	*Washingtonia filifera*	E, I
paloverde	*Cercidium* spp.	
pennyroyal	*Monardella* spp.	
penstemon	*Penstemon* spp.	
phlox, cushion	*Phlox pulvinata*	
phragmites	*Phragmites australis*	I
pine, Intermountain bristlecone	*Pinus longaeva*	
pine, Jeffrey	*Pinus jeffreyi*	
pine, limber	*Pinus flexilis*	
pine, lodgepole	*Pinus contorta*	
pine, ponderosa	*Pinus ponderosa*	
pine, sugar	*Pinus lambertiana*	
pine, western white	*Pinus monticola*	
pine, whitebark	*Pinus albicaulis*	
pinyon, singleleaf	*Pinus monophylla*	
pondweed	*Potamogeton* spp.	
pondweed, curly-leaf	*Potamogeton crispus*	E, I
pondweed, sago	*Potamogeton pectinatus*	
quailbush	*Atriplex lentiformis*	
rabbitbrush	*Chrysothamnus* spp.	
rabbitbrush, rubber	*Chrysothamnus nauseosus*	
ricegrass, Indian	*Achnatherum hymenoides*	
rice, wild	*Zizania* spp.	

rose, wild	*Rosa woodsii* var. *ultramontana*	
rush	*Juncus* spp.	
rush, Baltic	*Juncus balticus*	
rush, Sierra	*Juncus nevadensis*	
sacaton, alkali	*Sporobolus airoides*	
sage	*Salvia* spp.	
sagebrush	*Artemisia* spp.	
sagebrush, big	*Artemisia tridentata* ssp. *tridentata*	
sagebrush, black	*Artemisia nova*	
sagebrush, mountain	*Artemisia tridentata* var.*vaseyana*	
sagebrush, low	*Artemisia arbuscula*	
sagebrush, Wyoming	*Artemisia tridentata* var. *wyomingensis*	
salmonberry	*Rubus spectabilis*	
saltbush	*Atriplex* spp.	
saltbush, fourwing	*Atriplex canescens*	
saltbush, many-fruit	*Atriplex polycarpa*	
saltcedar	*Tamarix ramosissima*	E, I, N
saltgrass	*Distichlis spicata*	
sand-verbena, desert	*Abronia villosa*	
sedge, Ross	*Carex rossii*	
seepweed	*Suaeda moquinii*	
seepwillow	*Baccharis salicifolia*	
serviceberry	*Amelanchier* spp.	
shadscale	*Atriplex confertifolia*	
shooting star	*Dodecatheon jeffreyi*	
silktassel, ashy	*Garrya flavescens*	
silktassel, Wright's	*Garrya wrightii*	
smartweed	*Polygonum* spp.	
smartweed, water	*Polygonum amphibium*	
snapdragon	*Antirrhinum* spp.	
snowberry	*Symphoricarpos* spp.	
spikerush	*Eleocharis* spp.	
spruce, Engelmann	*Picea engelmannii*	
squaw-apple	*Peraphyllum ramosissimum*	
squirreltail	*Elymus elymoides*	
stork's bill	*Erodium cicutarium*	
sumac	Rhus spp.	
sumac, oakleaf	*Rhus trilobata*	
sycamore	*Platanus racemosa*	
thistle, Canada	*Cirsium arvense*	E, I, N
thistle, Musk	*Carduus nutans*	E, I, N
thistle, Russian	*Salsola tragus*	E, I
thistle, Scotch	*Onopordum acanthium*	E, I, N
timothy, alpine	*Phleum alpinum*	
toad-flax	*Linaria* spp.	E, I, N
tule	*Scirpus acutus*	

valerian, Western	*Valeriana occicidentalis*	
wheatgrass, bluebunch	*Pseudoroegneria spicata*	
wheatgrass, crested	*Agropyron desertorum*	E
wheatgrass, intermediate	*Elytrigia intermedia*	E
whitetop, tall (perennial pepperweed)	*Lepidium latifolium*	E, I, N
wigeongrass	*Ruppia maritima*	
wildrye, blue	*Elymus glaucus*	
wildrye, creeping	*Leymus triticoides*	
wildrye, Great Basin	*Leymus cinereus*	
willow	*Salix* spp.	
willow, arroyo	*Salix lasiolepis*	
willow, coyote	*Salix exigua*	
willow, desert	*Chilopsis linearis*	
willow, Goodding	*Salix gooddingii*	
willow, red	*Salix laevigata*	
willow, shining	*Salix lucida*	
winterfat	*Krascheninnikovia lanata*	
yarrow, common	*Achillea millefolium*	
yucca	*Yucca* spp.	

Scientific Name Arranged Alphabetically

Common Name	**Scientific Name**	**Status (E=Exotic; I=Invasive; N=Noxious)**
Abies concolor	fir, white	
Abies lasiocarpa	fir, subalpine	
Abies magnifica	fir, red	
Abronia villosa	sand-verbena, desert	
Acacia greggii	acacia, catclaw	
Acacia greggii	catclaw	
Acer macrophyllum	maple, bigtooth	
Achillea millefolium	yarrow, common	
Achnatherum hymenoides	ricegrass, Indian	
Achnatherum occidentalis	needlegrass, Western	
Adenostoma spp.	chamise	
Agave spp.	agave	
Agropyron desertorum	wheatgrass, crested	E
Allenrolfea occidentalis	iodinebush	
Alnus incana	alder, mountain	
Alnus rhombifolia	alder, white	
Alnus spp.	alder sp.	
Ambrosia dumosa	bursage, white	
Amelanchier spp.	serviceberry	
Antirrhinum spp	snapdragon	
Apium graveolens	celery, wild	E
Aquilegia spp.	columbine	
Arctostaphylos pungens	manzanita, Mexican	

Arctostaphylos patula	manzanita, greenleaf	
Arctostaphylos spp.	manzanita	
Artemisia arbuscula	sagebrush, low	
Artemisia nova	sagebrush, black	
Artemisia spinescens	budsage	
Artemisia spp.	sagebrush	
Artemisia tridentata ssp. *tridentata*	sagebrush, big	
Artemisia tridentata var. *wyomingensis*	sagebrush, Wyoming	
Artemisia tridentata var.*vaseyana*	sagebrush, mountain	
Aster spp.	aster	
Atriplex canescens	saltbush, fourwing	
Atriplex confertifolia	shadscale	
Atriplex hymenelytra	desert holly	
Atriplex hymenelytra	holly, desert	
Atriplex lentiformis	quailbush	
Atriplex polycarpa	saltbush, many-fruit	
Atriplex spp.	saltbush	
Baccharis salicifolia	seepwillow	
Balsamorhiza sagittata	balsamroot, arrowleaf	
Berberis repens	barberry, creeping	
Betula occidentalis	birch, water	
Betula spp.	birch	
Bouteloua gracilis	grama, blue	
Brassica tournefortii	mustard, sahara	E, I, N
Bromus madritensis var. *rubens*	brome, red	E, I
Bromus tectorum	cheatgrass	E, I
Calocedrus decurrens	cedar, incense	
Camassia quamash	camassia	
Carduus nutans	thistle, Musk	E, I, N
Castilleja spp.	paintbrush, Indian	
Ceanothus greggii var. *vestitus*	ceanothus, cup-leaf	
Ceanothus spp.	ceanothus	
Ceanothus velutinus	buckbrush	
Celtis reticulata	hackberry	
Cercidium spp.	paloverde	
Cercocarpus intricatus	mountain-mahogany, littleleaf	
Cercocarpus ledifolius	mountain-mahogany, curlleaf	
Cercocarpus spp.	mountain-mahogany	
Cercocarpus. montanus	mountain-mahogany, alderleaf	
Chamerion spp.	fireweed	
Chilopsis linearis	willow, desert	
Chrysolepis sempervirens	chinquapin	
Chrysothamnus nauseosus	rabbitbrush, rubber	
Chrysothamnus spp.	rabbitbrush	
Cirsium arvense	thistle, Canada	
Cleome serrulata	beeflower	
Coleogyne ramosissima	blackbrush	
Cornus sericea	dogwood, red-osier	

Cornus spp.	dogwood	
Cyperus spp.	flatsedge	
Delphinium spp.	larkspur	
Deschampsia cespitosa	hairgrass, tufted	
Deschampsia elongata	hairgrass, slender	
Descurainia spp.	mustard, tansy	E, I
Distichlis spicata	saltgrass	
Dodecatheon jeffreyi	shooting star	
Elaeagnus angustifolius	olive, Russian	E, I
Eleocharis spp.	spikerush	
Egeria densa	elodea, Brazilian	E, I
Elymus elymoides	squirreltail	
Elymus glaucus	wildrye, blue	
Elytrigia intermedia	wheatgrass, intermediate	E
Ephedra spp.	Mormon tea	
Erica spp.	heath	E
Eriogonum fasciculatum	buckwheat, California	
Erodium cicutarium	stork's bill	
Festuca idahoensis	fescue, Idaho	
Fouquieria splendens spp. *splendens*	ocotillo	
Fraxinus velutina	ash, velvet	
Garrya flavescens	silktassel, ashy	
Garrya wrightii	silktassel, Wright's	
Geranium viscosissimum	geranium, sticky	
Geum rossii	avens, alpine	
Grayia spinosa	hopsage	
Halogeton glomeratus	halogeton	E, I
Hesperostipa comata	grass, needle-and-thread	
Hesperostipa comata	needle-and-thread	
Hyptis emoryi	lavender, desert	
Ipomopsis aggregata	gilia, scarlet	
Juncus balticus	rush, Baltic	
Juncus nevadensis	rush, Sierra	
Juncus spp.	rush	
Juniperus californica	juniper, California	
Juniperus communis	juniper, common	
Juniperus occidentalis	juniper, western	
Juniperus osteosperma	juniper, Utah	
Juniperus scopulorum	juniper, Rocky Mountain	
Justica californica	chuparosa	
Krascheninnikovia lanata	winterfat	
Larrea tridentata	creosote bush	
Lepidium latifolium	whitetop, tall (perennial pepperweed)	E, I, N
Leymus cinereus	wildrye, Great Basin	
Leymus triticoides	wildrye, creeping	
Lilium spp.	lily	
Linaria spp.	toad-flax	E, I, N
Lonicera spp.	honeysuckle	

Lupinus spp.	lupine	
Lycium spp.	boxthorn	
Lycium spp.	desert-thorn	
Lycium spp.	lycium	
Monardella spp.	horsemint	
Monardella spp.	pennyroyal	
Nitrophila occidentalis	borax-weed, western	
Nymphaea spp.	lily, water	
Onopordum acanthium	thistle, Scotch	E, I, N
Opuntia acanthocarpa	cholla, buckhorn	
Opuntia basilaris	cactus, beavertail	
Opuntia spp.	cholla	
Osmorhiza occidentalis	cicely, Western sweet	
Penstemon spp.	penstemon	
Pentaphylloides fruticosa	cinquefoil, shrubby	
Peraphyllum ramosissimum	squaw-apple	
Phleum alpinum	timothy, alpine	
Phlox pulvinata	phlox, cushion	
Phoradendron californicum	mistletoe, desert	
Phoradendron spp.	mistletoe	
Phragmites australis	phragmites	I
Picea engelmannii	spruce, Engelmann	
Pinus albicaulis	pine, whitebark	
Pinus contorta	pine, lodgepole	
Pinus flexilis	pine, limber	
Pinus jeffreyi	pine, Jeffrey	
Pinus lambertiana	pine, sugar	
Pinus longaeva	pine, Intermountain bristlecone	
Pinus monophylla	pinyon, singleleaf	
Pinus monticola	pine, western white	
Pinus ponderosa	pine, ponderosa	
Platanus racemosa	sycamore	
Pleuraphis jamesii	galleta	
Pluchea sericea	arrowweed	
Poa spp.	bluegrass	
Polygonum amphibium spp.	smartweed, water	
Polygonum spp.	smartweed	
Populus deltoides var. *fremontii*	cottonwood, Fremont	
Populus tremuloides	aspen	
Populus tremuloides	aspen, quaking	
Populus trichocarpa	cottonwood, black	
Potamogeton crispus	pondweed, curly-leaf	E, I
Potamogeton pectinatus	pondweed, sago	
Potamogeton spp.	pondweed	
Potentilla spp.	cinquefoil	
Prosopis glandulosa	mesquite, honey	
Prosopis pubescens	mesquite, screwbean	
Prunus emarginata	bittercherry	

Prunus virginiana	chokecherry	
Pseudoroegneria spicata	wheatgrass, bluebunch	
Pseudotsuga menziesii	fir, Douglas	
Psorothamnus spp.	dalea	
Pteridium aquilinum	fern, bracken	
Purshia stansburiana	cliffrose	
Purshia tridentata	bitterbrush, antelope	
Purshia tridentata	bitterbrush	
Quercus gambelli	oak, Gambel's	
Quercus kelloggii	oak, black	
Quercus spp.	oak, scrub	
Quercus turbinella	liveoak, shrub	
Quercus turbinella	oak, shrub live	
Rhamnus spp.	buckthorn	
Rhus spp.	sumac	
Rhus trilobata	sumac, oakleaf	
Ribes aureum	currant, golden	
Ribes cereum	currant, squaw	
Ribes nevadense	currant, Sierra	
Ribes roezlii	gooseberry, mountain	
Ribes spp.	currant	
Rosa woodsii var. *ultramontana*	rose, wild	
Rubus spectabilis	salmonberry	
Ruppia maritima	wigeongrass	
Sagittaria cuneata	arrowhead	
Salix exigua	willow, coyote	
Salix gooddingii	willow, Goodding	
Salix laevigata	willow, red	
Salix lasiolepis	willow, arroyo	
Salix lucida	willow, shining	
Salix spp.	willow	
Salsola tragus	thistle, Russian	E, I
Salvia spp.	sage	
Sambucus racemosa	elderberry, red	
Sambucus spp.	elder	
Sarcobatus vermiculatus	greasewood	
Scirpus acutus	bulrush, hardstem	
Scirpus acutus	tule	
Scirpus maritimus	bulrush, alkali	
Scirpus spp.	bulrush	
Shepherdia argentea	buffaloberry	
Sparganium spp.	burreed	
Sphaeralcea spp.	globemallow	
Sporobolus airoides	sacaton, alkali	
Sporobolus cryptandrus	dropseed, sand	
Suaeda moquinii	seepweed	
Symphoricarpos spp.	snowberry	
Taeniatherum caput-medusae	medusahead	E, I, N

Tamarix ramosissima	saltcedar	E, I, N
Tetradymia tetrameres	horsebrush, four-part	
Thalictrum fendleri	meadowrue, Fendler	
Tsuga mertensiana	hemlock, mountain	
Typha spp.	cattail	
Valeriana occicidentalis	valerian, Western	
Veratrum californicum	hellebore, false	
Washingtonia filifera	palm, California fan	E, I
Wyethia amplexicaulis	mule's ears, northern	
Wyethia mollis	mule's ears, mountain	
Yucca brevifolia	Joshua tree	
Yucca spp.	yucca	
Zizania spp.	rice, wild	

Noxious Weed List (NRS 555)

Category A Weeds are generally not found or that are limited in distribution throughout the State. Such weeds are subject to: (a) Active exclusion from the State and active eradication wherever found; (b) Active eradication from the premises of a dealer of nursery stock.

Common Name	Scientific Name	Common Areas Found
African rue	*Peganum harmala*	dry, alkali
Austrian fieldcress	*Rorippa austriaca*	wet soils, marshes, wet meadows
Black henbane	*Hyoscyamus niger*	pastures, roadsides
Camelthorn	*Alhagi pseudalhagi*	dry soils, moist areas, riparian
Common crupina	*Crupina vulgaris*	rangelands, forest, grasslands
Common St. Johnswort	*Hypericum perforatum*	shrublands with sandy, gravely soils
Crimson fountain grass	*Pennisetum setaceum*	dry areas, rocky soils, dry riverbeds
Dalmatian toadflax	*Linaria dalmatica*	roadsides, rangelands
Dyer’s woad	*Isatis tinctoria*	roadsides, disturbed sites, pastures, rangeland
Eurasian watermilfoil	*Myriophyllum spicatum*	aquatic systems
Giant reed	*Arundo donax*	wetlands
Giant salvinia	*Salvinia molesta* and other *S.* spp.	aquatic
Goatsrue	*Galega officinalis*	agricultural areas, waterways, marshes
Houndstongue	*Cynoglossum officinale*	pastures, roadsides, disturbed areas
Hydrilla	*Hydrilla verticillata*	aquatic
Iberian starthistle	*Centaurea iberica*	roadsides, disturbed areas
Malta starthistle	*Centaurea melitensis*	roadsides, disturbed areas
Mayweed chamomile	*Anthemis cotula*	agricultural areas, pastures
Mediterranean sage	*Salvia aethiopis*	pastures, meadows, open areas
Perennial sowthistle	*Sonchus arvensis*	moist areas, agricultural areas, ditchbanks
Purple loosestrife	*Lythrum salicaria, L. virgatum* & cultivars	wetlands, riparian, agricultural areas
Purple starthistle	*Centaurea calcitrapa*	roadsides, disturbed agricultural areas
Rush skeletonweed	*Chondrilla juncea*	disturbed soils, rangeland, pastures
Spotted knapweed	*Centaurea maculosa*	any disturbed soils
Squarrose knapweed	*Centaurea virgata*	rangelands
Sulfur cinquefoil	*Potentilla recta*	disturbed areas, roadsides
Swainsonpea	*Sphaerophysa salsul*	roadsides, fencelines

Syrian beancaper	*Zygophyllum fabago*	dry saline sites, disturbed soils
Yellow starthistle	*Centaurea solstitialis*	roadsides, disturbed areas
Yellow toadflax	*Linaria vulgaris*	rangelands, shrublands

Category B Weeds that are generally established in scattered populations in some counties of the State. Such weeds are subject to: (a) Active exclusion where possible; (b) Active eradication from the premises of a dealer of nursery stock.

Common Name	Scientific Name	Common Areas Found
African mustard	*Brassica tournefortii*	disturbed areas, desert shrublands
Diffuse knapweed	*Centaurea diffusa*	dry rangelands, overgrazed pasture, roadsides
Horsenettle	*Solanum carolinense*	wetlands, riparian, agricultural areas, pasture
Leafy spurge	*Euphorbia esula*	pasturelands, wet meadows
Medusahead	*Taeniatherum caput-medusae*	dry, rangeland, pastures
Musk thistle	*Carduus nutans*	agricultural, riparian, wetlands, meadows
Russian knapweed	*Acroptilon repens*	highly disturbed areas, roadsides, fields
Scotch thistle	*Onopordum acanthium*	roadsides, disturbed areas, fields
Silverleaf nightshade	*Solanum elaeagnifolium*	riparian, wetlands, agricultural areas

Category C Weeds are weeds that are generally established and generally widespread in many counties of the State. Such weeds are subject to active eradication from the premises of a dealer of nursery stock.

Common Name	Scientific Name	Common Areas Found
Canada thistle	*Cirsium arvense*	riparian, agricultural areas
Hoary cress	*Cardaria draba*	highly disturbed areas, riparian, agricultural, meadows, alkali soils
Johnsongrass	*Sorghum halepense*	fields, agricultural areas, meadows
Perennial pepperweed	*Lepidium latifolium*	riparian, wetlands, agricultural areas
Poison-hemlock	*Conium maculatum*	riparian, wetlands, irrigation
Puncturevine	*Tribulus terrestris*	disturbed soils in open areas, fields
Salt cedar (tamarisk)	*Tamarix* spp.	riparian, ornamental landscapes
Spotted water hemlock	*Cicuta maculata*	poorly drained soils, ditchbanks

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APPENDIX K

2005 WILDLIFE ACTION PLAN INFORMATION

2005 WAP Development and Review Process

Public Involvement and Partnerships

A series of public scoping meetings were held throughout the state in February, 2003. Presentations were made in Reno, Las Vegas, and Elko to introduce Nevadans to the concept and opportunity of the WAP. Over 100 invitations were sent out to agencies, NGOs, and, hunting, fishing, and environmental groups. Attendance to these initial presentations was very light, but the themes that emerged from the discussions were very useful in guiding the WAP development strategy. Attendees were supportive of an inclusive, collaborative approach to developing the Strategy, they advocated the integration of existing and ongoing planning efforts into the WAP, and they advocated the sharing and consolidation of data into comprehensive databases.

The next step in collaborative planning for the WAP was taken in August, 2003 when NDOW commissioned a working group of active individuals from the conservation community to work on alternative funding for the Wildlife Diversity program. This working group met several times in the next two years and provided input and guidance into the process.

WAP Development Team members attended a Rural Planning Conference on January 20, 2005, to introduce the Strategy to county planners and solicit their attendance and participation in the upcoming round of open houses across the state. Following the development of a series of draft analytical products, the WAP Development Team took the draft analysis on the road for a seven-city tour of Nevada to receive a second round of input. The meetings were held in open-house format in Reno, Carson City, Las Vegas, Tonopah, Ely, Elko, and Winnemucca between March 16 and 31, 2005. The open house meetings were held between 1 p.m. and 7 p.m. in cities where the maximum access to federal land management agency district offices could be most efficiently achieved. The WAP tour was advertised in the media and invitations were sent out to hundreds of contacts representing all possible conservation partners that could be identified, including federal and state resource agencies, county governments, tribes, sportsmen's groups, agricultural and mining industry representatives, environmental groups, conservation organizations, recreation groups, university personnel, and others.

In addition to the eight open houses, invitations were sent to 27 sportsmen's and environmental organizations offering a special appointment presentation of the WAP to their organization. As a result of the focus group invitations, eight meetings were held with specific focus groups comprised of organization members (Lahontan Audubon Society, the Fallon Chapter of Nevada Bighorns Unlimited, the Reno Chapter of the Mule Deer Foundation, University of Nevada Natural Resources and Environmental Sciences Department) or representatives from several organizations (Coalition For Nevada's Wildlife, a southern Nevada Sportsman's Caucus, and a waterfowl hunter focus group). In addition, Eureka County personnel invited the WAP team to make a two-hour evening presentation to Eureka residents on April 27, 2005. In all, attendance to all the WAP open houses and workshops exceeded 150 individuals representing over 60 organizations. Attendees viewed a PowerPoint presentation outlining the rationale and approach of the WAP, inspected a series of draft analytical products, including the Species of Conservation Priority lists, the proposed ecological frameworks for both terrestrial and aquatic species, the proposed "key habitat strategy groups" developed from Southwest ReGAP, and responded to a short series of inventory questions, including the following five:

- Are these the right Species of Conservation Priority?
- Does this habitat classification system and geographic framework make sense to you?
- What are the most serious conservation challenges facing us over the next ten years?
- What are your organization's top priorities for the next ten years?
- What are the opportunities to work together to achieve significant wildlife conservation in the next ten years?

Input received during this draft analytical review was not only incorporated into the strategies of the Draft Plan, but also influenced future data analysis and organizational structure of the Draft Plan.

A final partnership group was convened May 3-4, 2005, consisting of implementation partners from the Governor's Sage Grouse Conservation Team. This group included representatives from the Nevada Farm Bureau, Nevada Department of Agriculture, U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, Nevada Mining Association, and Nevada Cooperative Extension. The group focused on developing a set of "guiding principles" for the WAP writing team to consider while preparing the Draft Plan, as mentioned in prior sections of this document.

Coordination with Agencies & Tribes

The Nevada WAP Development Team stayed in close contact with agency personnel throughout development of the Draft Plan. Coordination was maintained with the USFWS offices in Reno and Las Vegas, the BLM State Office, and the Humboldt-Toiyabe National Forest's Supervisor's Office. Multiagency and non-governmental organization feedback was received through several Nevada Partners In Flight meetings dating back to 2002. Nevada PIF provided expert assistance in the development of bird species assemblages at their Spring, 2005 meeting. Another expert committee was convened to receive assistance in the development of mammal and reptile species assemblages, and that workshop was also well attended.

Because of the short review interval, limited personnel availability, and budget constraints, it was impossible for the WAP Development Team to hold individual workshops with all the district offices of BLM, USFWS, USFS, USBR, state agencies, and others. This is why the expanded-format open house in strategically selected cities across the state was selected as the method of draft product review and inventory. The desired outcome of the open houses was to provide agency employees and private citizens with adequate opportunity to visit the open house sometime during the afternoon or early evening. The open house strategy was fairly successful – BLM employees attended all seven; USFS employees attended six of seven; USFWS employees attended three of seven; and Nevada Division of Forestry, Natural Heritage Program, Department of Agriculture, Division of State Lands employees, Naval Air Station Fallon, and USBR employees each attended one open house.

One of the primary strategies of the WAP is to integrate its objectives and actions with other agency planning processes to foster synergistic achievement of wildlife management objectives at a statewide scale. Currently in Nevada, the BLM Resource Management Plan process is in a renewal cycle and both the Humboldt-Toiyabe and Lake Tahoe Basin Management Unit Forest Plans are in revision. The involvement of The Nature Conservancy members of the WAP Development Team in the conservation design of the Humboldt-Toiyabe Forest Plan has resulted in a particularly tight integration between the two planning efforts – one that is expected to make each effort stronger and more effective. Similar opportunities to provide WAP products and services to the Lake Tahoe Basin Management Unit Forest Plan revision and the ongoing round of BLM Resource Management Plan revisions will be sought as major deliverables of the WAP.

Other opportunities to integrate into resource planning efforts include the NRCS Nevada WHIP Plan and the various Habitat Conservation Plans in place or being developed (Clark County, Lincoln County, Colorado River, Virgin River, and Nye County). During Phase II of WAP implementation, the Development Team anticipates partnering with Nevada Division of State Lands to build integration products and services for other county planning efforts, including resource plans, open space plans, recreation plans, and Quality of Life evaluations.

The coordination of the Nevada WAP with tribal lands management strategies is particularly important now with the advent of the federal Tribal Wildlife Grant (TWG) program. Tribal coordination will be facilitated through the Nevada Indian Commission, which maintains liaison with all the Native American tribes in Nevada. An introductory meeting was held in July 2005 during which the WAP program was presented to tribal representatives and a strategy for proceeding with a WAP/TWG partnership was commissioned. The WAP Development Team will extend its planning experience to tribes wishing to access TWG funds to assist them in identifying priorities, program and project design and development, and provide grant application training and start-up assistance, with the objective of integrating tribal wildlife priorities and management approaches into the Nevada WAP to achieve synergy between the two sister Federal Aid programs.

Identifying Species of Conservation Priority-2005

The Species of Conservation Priority identification process for nongame terrestrial vertebrates (birds, mammals, and reptiles) began in July, 2002. After initially gathering input from partner land management agency personnel at the field level, a Species Priority Matrix (see Appendix A.) was developed using standard species conservation prioritization methodology (Natural Heritage Scorecard; Panjabi et al. 2001). A separate prioritization process was developed for fish, amphibians, and mollusks by the NDOW Fisheries Bureau in December, 2004, and the NDOW Game Bureau designed and executed the Game Animals prioritization process in early 2005.

Birds

The species priority processes identified 72 bird species as Species of Conservation Priority, including 4 upland game birds and four hunted waterfowl species (Table 1.) Of the total, there are 25 species of water birds, 8 birds of prey, and 39 other land birds. Two species, Yuma Clapper Rail and Southwestern Willow Flycatcher are listed as Endangered under the Federal Endangered Species Act, the Bald Eagle is federally listed as Threatened, and the Yellow-billed Cuckoo is federally listed as a Candidate Species and is also listed as a Sensitive Species in Nevada. Three species are listed as State Sensitive – Northern Goshawk, Loggerhead Shrike, and Brewer's Sparrow. The availability and productivity of water, wetlands and riparian areas loom large as influential in the prioritization of species in Nevada. Twenty-five priority species are associated with open water or wetlands, while another 20 land birds are predominantly associated with riparian habitats. Twelve priority species are primarily found in the Mojave Desert, which translates toward higher area responsibility for Nevada since it shares the Mojave Desert with only three other states. Six species are coniferous forest dwellers – a habitat type of restricted distribution in the state.

Table 1. Nevada Species of Conservation Priority - Birds

Species Common Name	Scientific Name
Common Loon	*Gavia immer*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
American White Pelican	*Pelecanus erythrorhynchos*

Western Least Bittern	*Ixobrychus exilis*
Snowy Egret	*Egretta thula*
White-faced Ibis	*Plegadis chihi*
Northern Pintail	*Anas acuta*
Cinnamon Teal	*Anas cyanoptera*
Canvasback	*Aythya valiseneria*
Redhead	*Aythya americana*
Bald Eagle (contiguous U.S. pop)	*Haliaeetus leucocephalus*
Northern Goshawk	*Accipiter gentilis*
Swainson's Hawk	*Buteo swainsoni*
Ferruginous Hawk	*Buteo regalis*
Peregrine Falcon	*Falco peregrinus*
Mountain Quail	*Oreortyx pictus*
Blue Grouse	*Dendragapus obscurus*
Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus*
Greater Sage-Grouse	*Centrocercus urophasianus*
Yuma Clapper Rail	*Rallus longirostris yumanensis*
Greater Sandhill Crane	*Grus canadensis*
Western Snowy Plover	*Charadrius alexandrinus*
Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Willet	*Catoptrophorus semipalmatus*
Long-billed Curlew	*Numenius americanus*
Least Sandpiper	*Calidris minutilla*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Red-necked Phalarope	*Phalaropus lobatus*
Franklin's Gull	*Larus pipixcan*
Forster's Tern	*Sterna forsteri*
Black Tern	*Chlidonias niger*
Western Yellow-billed Cuckoo	*Coccyzus americanus*
Western Burrowing Owl	*Athene cunicularia*
California Spotted Owl	*Strix occidentalis*
Short-eared Owl	*Asio flammeus*
White-throated Swift	*Aeronautes saxatalis*
Costa's Hummingbird	*Calypte costae*
Rufous Hummingbird	*Selasphorus rufus*
Lewis' Woodpecker	*Melanerpes lewis*
Red-breasted Sapsucker	*Sphyrapicus ruber*
White-headed Woodpecker	*Picoides albolarvatus*
Olive-sided Flycatcher	*Contopus borealis*
Willow Flycatcher	*Empidonax traillii adastus*
Mountain Willow Flycatcher	*Empidonax traillii brewsteri*
Southwestern Willow Flycatcher	*Empidonax traillii extimus*
Black Phoebe	*Sayornis nigricans*

Mammals

Sixteen priority mammal species have "protected" status in Nevada. Of those, eight species are further listed as "Sensitive," and one species (spotted bat) is further listed as "Threatened" under Nevada Administrative Code. Three species (Ash Meadows montane vole, Hidden Forest Uinta chipmunk, and Sierra Nevada red fox) may be extinct in Nevada. Thirteen of Nevada's 23 bat species made the priority list, reflecting a recent intensity of focus associated with the drafting of the Nevada Bat Conservation Plan. Seven species of shrews made the list because so little is known about their status and distribution in the state. Sixteen priority rodent species exist in Nevada in fragmented populations, and as such may require local conservation action to maintain them.

Table 2. Nevada Species of Conservation Priority – Mammals

Species Common Name	Scientific Name
Merriam's shrew	*Sorex merriami*
Trowbridge's shrew	*Sorex trowbridgii*
vagrant shrew	*Sorex vagrans*
montane shrew	*Sorex monticolus*
Inyo shrew	*Sorex tenellus*
water shrew	*Sorex palustris*
Preble's shrew	*Sorex preblei*
broad-footed mole	*Scapanus latimanus*
California leaf-nosed bat	*Macrotus californicus*
little brown myotis	*Myotis lucifrugus*
fringed myotis	*Myotis thysanodes*
western small-footed myotis	*Myotis ciliolabrum*
long-eared myotis	*Myotis evotis*
cave myotis	*Myotis velifer*
Allen's big-eared bat	*Idionycteris phyllotis*
western red bat	*Lasiurus blossevillii*
hoary bat	*Lasiurus cinereus*
western yellow bat	*Lasiurus xanthinus*
spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Corynorhinus townsendii*
big free-tailed bat	*Nyctinomops macrotis*
American pika	*Ochotona princeps*
pygmy rabbit	*Brachylagus idahoensis*
Aplodontia	*Aplodontia rufa*
mountain pocket gopher	*Thomomys monticola*
Fish Spring pocket gopher	*Thomomys bottae abstrusus*
San Antonio pocket gopher	*Thomomys bottae curtatus*
desert pocket mouse	*Chaetodipus pencillatus*
Fletcher dark kangaroo mouse	*Microdipidops megacephalus*
Desert Valley kangaroo mouse	*Microdipidops megacephalus nasutus*
pale kangaroo mouse	*Microdipidops pallidus*
California kangaroo rat	*Dipodomys californicus*
desert kangaroo rat	*Dipodomys deserti*
brush mouse	*Peromyscus boylei*
Ash Meadows montane vole	*Microtus montanus nevadensis*
Pahranagat Valley montane vole	*Microtus montanus fucosus*
sagebrush vole	*Lemmiscus curtatus*
Wyoming ground squirrel	*Spermophilus elegans nevadensis*
Allen's chipmunk	*Tamias senex*
Humboldt yellow-pine chipmunk	*Tamias amoenus celeris*
Hidden Forest Uinta chipmunk	*Tamias umbrinus nevadensis*
Palmer's chipmunk	*Tamias palmeri*

northern flying squirrel	*Glaucomys sabrinus*
western jumping mouse	*Zapus princeps*
Sierra Nevada red fox	*Vulpes vulpes necator*
kit fox	*Vulpes macrotis*
ringtail	*Bassaryscus astutus*
American marten	*Martes americana*
northwestern river otter	*Lontra canadensis*
mule deer	*Odocoileus hemionus*
Nelson bighorn sheep	*Ovis canadensis nelsoni*
California bighorn sheep	*Ovis canadensis canadensis*

Reptiles

Eighteen reptiles were identified as priority species through the Species Priority Matrix process. Two more species, western diamondback rattlesnake and Panamint alligator lizard, were added during stakeholder review, bringing the priority reptile total to 20 (Table 3). The desert tortoise is listed as Threatened under the Endangered Species Act. The banded Gila monster is protected in Nevada under NAC 503. Although its origin cannot be absolutely determined, the northwestern pond turtle may be Nevada's only native aquatic turtle, and it now persists only in small populations in the Truckee and Carson Rivers. The Sonoran mountain kingsnake occurs in what are thought to be very small fragmented populations in east-central Nevada. These populations appear not to be connected to the species' larger range in central Utah.

Little is known about the population dynamics of the remaining priority reptiles, arousing concerns over various population pressures from excessive specimen collection to habitat loss.

Table 3. Nevada Species of Conservation Priority – Reptiles

Species Common Name	Scientific Name
northwestern pond turtle	*Clemmys marmorata*
desert tortoise	*Gopherus agassizii*
western banded gecko	*Coleonyx variegatus*
common chuckwalla	*Sauromalus obesus*
desert iguana	*Dipsosaurus dorsalis*
Great Basin collared lizard	*Crotaphytus bicynctores*
Long-nosed leopard lizard	*Gambelia wislezenii*
desert horned lizard	*Phrynosoma platyrhinos*
greater short-horned lizard	*Phrynosoma hernandesi*
pygmy short-horned lizard	*Phrynosoma douglasii*
desert night lizard	*Xantusia vigilis*
long-tailed brush lizard	*Urosaurus graciosus*
Gilbert's skink	*Eumeces gilberti*
Sierra alligator lizard	*Elgaria coerulia shastensis*
Shasta alliagator lizard	*Elgaria coerulia palmeri*
Panamint alligator lizard	*Elgaria panamintina*
banded Gila monster	*Heloderma suspectum cinctum*
Sonoran mountain kingsnake	*Lampropeltis pyromelana*
Sonoran lyre snake	*Trimorphodon biscutatus*
western diamondback rattlesnake	*Crotalis atrox*

Fishes

The species priority process identified 40 fish species and subspecies as Species of Conservation Priority, including 23 minnows and carp, 7 splitfins (springfishes and poolfishes), 5 suckers, 3 pupfishes and 2 salmonids. Of these, 32 are listed as Sensitive Species in Nevada; 25 are also listed as Endangered (19) or Threatened (6) under the Endangered Species Act. More so than terrestrial wildlife species, the taxonomic diversity and distribution of Nevada's fishes are influenced by our state's geologic and hydrographic history (Hubbs and Miller 1948; Hubbs et al. 1974). Throughout the Great Basin ecoregion, glacial and postglacial changes in climate and hydrology have alternately connected and isolated hydrologic systems and their associated biota, creating a globally unique endemic aquatic fauna of surprising diversity. Of the 41 fish Species of Conservation Priority, 32 are endemic to Nevada. The state plays a critical role in species conservation for another 6 fish, though the species' ranges extend beyond Nevada's borders. Most fish populations in Nevada are isolated geographically; and 32 of the Species of Conservation Priority have disjunct or fragmented habitat (no significant connection between multiple locations, or only one location) and another 3 have a fair degree of habitat fragmentation. Other endemic fishes with lower conservation need rankings remain important elements of Nevada's native biota and diversity, and active conservation is essential for all of these species to ensure their persistence for future generations. Table 5 contains only those fish species deemed of greatest conservation priority (Species of Conservation Priority); a complete list of fish species is found in Appendix H (Comprehensive Nevada Species List), and information about conservation actions for those with lower rankings can be found in the Implementation, Effectiveness Monitoring, and Adaptive Management Section, Aquatics Sub-section.

Table 4. Nevada Species of Conservation Priority – Fishes

Common Species Name	Scientific Name
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*
Big Smokey Valley speckled dace	*Rhinichthys osculus lariversi*
Big Smokey Valley tui chub	*Gila bicolor* ssp. (unnamed)
Big Spring spinedace	*Lepidomeda mollispinis pratensis*
Bonytail	*Gila elegans*
Bull trout	*Salvelinus confluentus*
Clover Valley speckled dace	*Rhinichthys osculus oligoporus*
Cui-ui	*Chasmistes cujus*
Desert dace	*Eremichthys acros*
Devils Hole pupfish	*Cyprinodon diabolis*
Diamond Valley speckled dace	*Rhinichthys osculus* ssp. (unnamed)
Fish Lake Valley tui chub	*Gila bicolor* ssp. (unnamed)
Flannelmouth sucker	*Catostomus latipinnis*
Hiko White River springfish	*Crenichthys baileyi grandis*
Independence Valley speckled dace	*Rhinichthys osculus lethoporus*
Independence Valley tui chub	*Gila bicolor isolata*
Lahontan Cutthroat Trout - Quinn/BlackRock and Upper Humboldt Distinct Population Segment	*Oncorhynchus clarkii henshawi*
Lahontan Cutthroat Trout - Western Distinct Population Segment	*Oncorhynchus clarkii henshawi*
Moapa dace	*Moapa coriacea*
Moapa speckled dace	*Rhinichthys osculus moapae*
Moapa White River springfish	*Crenichthys baileyi moapae*
Monitor Valley speckled dace	*Rhinichthys osculus* ssp. (unnamed)

Moorman White River springfish	*Crenichthys baileyi thermophilus*
Oasis Valley speckled dace	*Rhinichthys osculus* ssp. (unnamed)
Pahranagat roundtail chub	*Gila robusta jordani*
Pahranagat speckled dace	*Rhinichthys osculus velifer*
Pahrump poolfish	*Empetrichthys latos latos*
Preston White River springfish	*Crenichthys baileyi albivallis*
Railroad Valley springfish	*Crenichthys nevadae*
Railroad Valley tui chub	*Gila bicolor* ssp. (unnamed)
Razorback sucker	*Xyrauchen texanus*
Virgin River chub	*Gila seminuda*
Virgin spinedace	*Lepidomeda mollispinis mollispinis*
Wall Canyon sucker	*Catostomus* sp.
Warm Springs pupfish	*Cyprinodon nevadensis pectoralis*
White River desert sucker	*Catostomus clarkii intermedius*
White River speckled dace	*Rhinichthys osculus* ssp. (unnamed)
White River spinedace	*Lepidomeda albivallis*
White River springfish	*Crenichthys baileyi baileyi*
Woundfin	*Plagopterus argentissimus*

Amphibians

Seven amphibian species were designated Species of Conservation Priority, including four frogs and three toads. Of these, three are Candidates for ESA listing. The main factors are urban development, water diversions, and introduced species, especially bullfrogs. Habitat connectivity is especially important for amphibians since they need both aquatic habitats (at a minimum for breeding) and terrestrial habitats to complete their life cycle. Aquatic habitats are often in a state of flux (e.g. beaver dam complex successional processes) and may disappear for a variety of reasons. In order for a population to survive, there must be the ability to move to a new site; habitat fragmentation prevents this necessary movement.

Table 5. Nevada Species of Conservation Priority – Amphibians

Species Common Name	***Scientific Name***
Amargosa Toad	*Bufo nelsoni*
Great Basin Columbia Spotted Frog - NE sub-population	*Rana luteiventris*
Great Basin Columbia Spotted Frog - Toiyabe sub-population	*Rana luteiventris*
Great Plains Toad	*Bufo cognatus*
Mountain Yellow-Legged Frog	*Rana muscosa*
Northern Leopard Frog	*Rana pipiens*
Relict Leopard Frog	*Rana onca*
Southwestern Toad (aka Arizona Toad)	*Bufo microscaphus*

Bivalves

There are two scientific orders of bivalves in Nevada, the Unionoida (freshwater mussels) and the Veneroida (fingernail clams). The latter do not need a host and appear to be relatively ubiquitous in Nevada. Only one species of freshwater mussels (the California floater) was selected as a Species of Conservation Priority, although all the native freshwater mussel species in Nevada face the same threats, and others are even more sensitive to a decrease in water quality. An example is the Western Ridged Mussel, which has been extirpated elsewhere in its native range. Species of freshwater mussels that occur (or have occurred) in Nevada have been eliminated from portions of rivers and even entire watersheds in their western United States range through the combined effects of habitat loss, pollution, blockage of anadromous fish, and introduced species. Nearly three-quarters of all 297 native freshwater mussel species in North America are imperiled and nearly 35 went extinct in the last century. They are one of the most endangered groups of animals on Earth, yet little is known about their life history, habitat needs, or even how to distinguish different species - especially in western North America. Their lifecycle is closely linked to fish species, so impacts to fish also impact these bivalves. Without adequate knowledge of their current and historic distributions, most of the Nevada bivalves remain unranked. Information about conservation actions for the 4 freshwater mussel species not listed as Species of Conservation Priority (see Appendix H for a complete list) can be found in the Implementation, Effectiveness Monitoring, and Adaptive Management Section, Aquatics Sub-section.

Table 6. Nevada Species of Conservation Priority – Bivalves

Species Common Name	***Scientific Name***
alifornia Floater	*Anodonta californiensis*

Gastropods

There are 74 gastropods (snails) on the list of Species of Conservation Priority, the vast majority of which are springsnails, and one, the Elongate mud meadows Pyrg – Pyrgulopsis notidicola) which is an ESA Candidate species. None are currently on NDOW's protected list . Most springsnail populations are highly isolated because springs and seeps are widely dispersed and disconnected. Indeed, many species' entire range is in just one small spring. A number of springsnail populations are declining, almost faster than we can learn about them. Their aquatic habitats are rare and sensitive to drought and to the manner in which water resources are used.

Terrestrial mollusks and crustaceans, arachnids, and insects were not included in the species prioritization process for the initial round of planning. NDOW has statutory management responsibility for mammals, birds, reptiles, amphibians, fishes, mollusks and crustaceans, but does not have statutory management responsibility for other invertebrate families, including arachnids and insects. Statutory management responsibility for the management of insects in Nevada belongs to the NDOA, but to date, there has been very little state focus on the conservation of rare insects beyond participation in management strategy development for endangered butterflies which as a result of their federal listing have become the primary responsibility of the USFWS. The Nevada WAP Development Team contacted its key conservation partners in the management of terrestrial invertebrates with the intent of developing a conservation strategy, but the supporting biological information was insufficient to support moving forward before the WAP deadline. The WAP Team will convene an expert working group to construct a conservation strategy as a priority task in a future phase of WAP development and implementation. Key conservation partners will include the Biological Resources Research Center of the University of Nevada, Reno, Great Basin College, and the USFWS.

Table 7. Nevada Species of Conservation Priority – Gastropods

Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Hydrobe, Steptoe	*Eremopyrgus eganensis*	Springsnail, Lake Valley	*Pyrgulopsis sublata*
Juga, smooth	*Juga interioris*	Springsnail, Landyes	*Pyrgulopsis landeyi*

Common Name	Scientific Name	Common Name	Scientific Name
Pebblesnail, Ash Meadows	*Pyrgulopsis erythropoma*	Springsnail, large gland	*Pyrgulopsis basiglans*
Pebblesnail, Moapa	*Pyrgulopsis avernalis*	Springsnail, Lockes	*Pyrgulopsis lockensis*
Pebblesnail, Pahranagat	*Pyrgulopsis merriami*	Springsnail, longitudinal	*Pyrgulopsis anguina*
Pebblesnail, Pyramid Lake	*Fluminicola dalli*	Springsnail, median-	*Pyrgulopsis pisteri*
Pebblesnail, Turban	*Fluminicola turbiniformis*	Springsnail, Moapa	*Pyrgulopsis carinifera*
Pebblesnail, Virginia	*Fluminicola virginicus*	Springsnail, neritiform	*Pyrgulopsis neritella*
Snail, Badwater	*Assiminea infima*	Springsnail, northern	*Pyrgulopsis militaris*
Springsnail, Antelope Valley	*Pyrgulopsis pellita*	Springsnail, northern	*Pyrgulopsis serrata*
Springsnail, bifid duct	*Pyrgulopsis peculiaris*	Springsnail, northwest	*Pyrgulopsis variegata*
Springsnail, Big Warm	*Pyrgulopsis papillata*	Springsnail, Oasis Valley	*Pyrgulopsis micrococcus*
Springsnail, Butterfield	*Pyrgulopsis lata*	Springsnail, ovate Cain	*Pyrgulopsis pictilis*
Springsnail, Camp Valley	*Pyrgulopsis montana*	Springsnail, Pleasant	*Pyrgulopsis aurata*
Springsnail, carinate	*Pyrgulopsis carinata*	Springsnail, Sada's	*Pyrgulopsis sadai*
Springsnail, Carlin	*Pyrgulopsis bryantwalkeri*	Springsnail, small gland	*Pyrgulopsis bifurcata*
Springsnail, Corn Creek	*Pyrgulopsis fausta*	Springsnail, southeast	*Pyrgulopsis turbatrix*
Springsnail, Crittenden	*Pyrgulopsis lentiglans*	Springsnail, southern	*Pyrgulopsis anatina*
Springsnail, Crystal Spring	*Pyrgulopsis crystalis*	Springsnail, southern	*Pyrgulopsis umbilicata*
Springsnail, distal-gland	*Pyrgulopsis nanus*	Springsnail, southern	*Pyrgulopsis sulcata*
Springsnail, Dixie Valley	*Pyrgulopsis dixensis*	Springsnail, Spring	*Pyrgulopsis deaconi*
Springsnail, Duckwater	*Pyrgulopsis aloba*	Springsnail, squat Mud	*Pyrgulopsis limaria*
Springsnail, Duckwater	*Pyrgulopsis villacampae*	Springsnail, sterile basin	*Pyrgulopsis sterilis*
Springsnail, Elko	*Pyrgulopsis leporina*	Springsnail, sub-globose	*Pyrgulopsis orbiculata*
Springsnail, elongate Cain	*Pyrgulopsis augustae*	Springsnail, transverse	*Pyrgulopsis cruciglans*
Springsnail, elongate Mud	*Pyrgulopsis notidicola*	Springsnail, Twentyone	*Pyrgulopsis millenaria*
Springsnail, elongate-gland	*Pyrgulopsis isolata*	Springsnail, upper	*Pyrgulopsis hovinghi*
Springsnail, Emigrant	*Pyrgulopsis gracilis*	Springsnail, Vinyard's	*Pyrgulopsis vinyardi*
Springsnail, Fairbanks	*Pyrgulopsis fairbanksensis*	Springsnail, White River	*Pyrgulopsis sathos*
Springsnail, Fish Lake	*Pyrgulopsis ruinosa*	Springsnail, Wong's	*Pyrgulopsis wongi*
Springsnail, Flag	*Pyrgulopsis breviloba*	Tryonia, Amargosa	*Tryonia variegata*
Springsnail, flat-topped	*Pyrgulopsis planulata*	Tryonia, desert	*Tryonia porrecta*
Springsnail, Fly Ranch	*Pyrgulopsis bruesi*	Tryonia, grated	*Tryonia clathrata*
Springsnail, Hardy	*Pyrgulopsis marcida*	Tryonia, minute	*Tryonia ericae*
Springsnail, Hubbs	*Pyrgulopsis hubbsi*	Tryonia, Monitor	*Tryonia monitorae*
Springsnail, Humboldt	*Pyrgulopsis humboldtensis*	Tryonia, Point of Rocks	*Tryonia elata*
Springsnail, Kings River	*Pyrgulopsis imperialis*	Tryonia, sportinggoods	*Tryonia angulata*