

## 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).

# Nevada Wildlife Action Plan

---

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 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

# Nevada Wildlife Action Plan

---

behind (e.g., Pahrnagat 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

# Nevada Wildlife Action Plan

---

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.

# Nevada Wildlife Action Plan

---

- 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

# Nevada Wildlife Action Plan

---

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, Pahrnagat 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 20<sup>th</sup> 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

# Nevada Wildlife Action Plan

---

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

# Nevada Wildlife Action Plan

---

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 20<sup>th</sup> 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.

# Nevada Wildlife Action Plan

---

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,

## Nevada Wildlife Action Plan

---

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](http://www.heritage.nv.gov)) and on NatureServe Explorer ([www.NatureServe.org](http://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.

