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*

<table>
<thead>
<tr>
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<tr>
<td>Great Basin</td>
<td>33,297</td>
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<td>Columbia Plateau</td>
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<td>Mojave</td>
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<tr>
<td>Sierra Nevada</td>
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<td><strong>Total</strong></td>
<td><strong>40,892</strong></td>
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</tbody>
</table>

**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 influence 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
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.

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### 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.

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### 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.


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” – allCharadriid 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**

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**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
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

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Ecological Systems*

*SWReGAP Ecological Systems

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*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 subspecies. 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 reservoir 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**

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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
- Eagle 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

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<td>Owyhee River Area</td>
<td>Ruby Valley</td>
<td>Sheldon NWR</td>
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<td>Crooks Lake and plateau</td>
<td>Piute Valley</td>
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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

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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 due to 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 southwestern 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**

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### 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 Las Vegas Valley
Big Smoky Valley Railroad Valley
Black Rock Desert West Sheldon NWR
Bog Hot Valley Spring Valley
Carson Sink
Fish Lake Valley
Indian Springs 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

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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**

<table>
<thead>
<tr>
<th>Land Owner/Manager</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Bureau of Land Management</td>
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<tr>
<td>Private</td>
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<td>National Park Service</td>
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<td>Department of Defense</td>
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<tr>
<td>U.S. Bureau of Reclamation</td>
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</table>
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