Intermountain Cold Desert Shrub

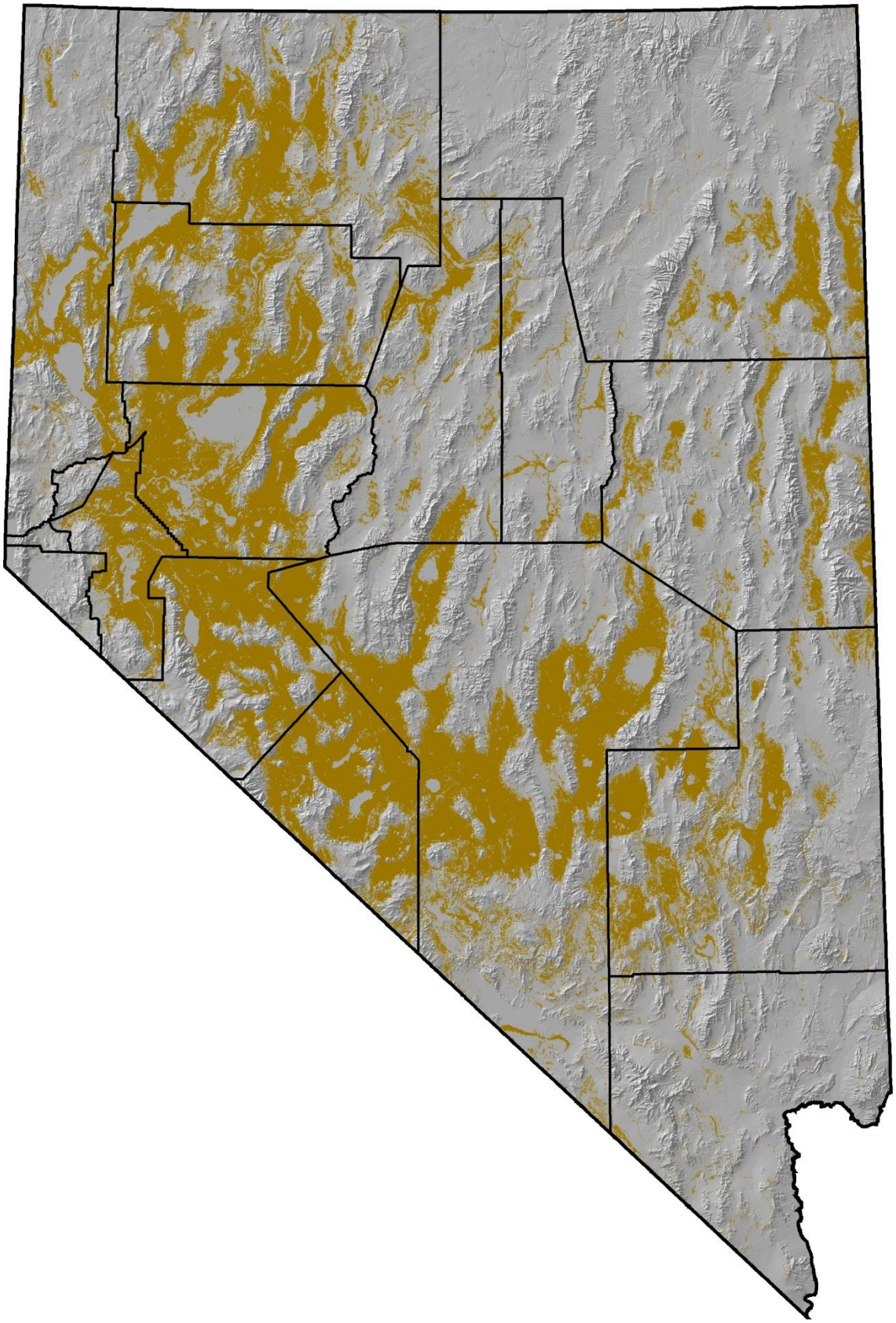

Figure 6. Distribution of Intermountan Cold Desert Shrub in Nevada.

KEY HABITAT: INTERMOUNTAIN COLD DESERT SHRUB

Things to Know….

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

Ecoregions

Southwest ReGAP 2005

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

Ecological Systems

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

Key Habitat Description

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

Community composition is largely influenced by soil salinity and drainage. Most often, the salt desert shrub type is dominated by either shadscale or greasewood. At the lowest flats of the valleys where soils drain poorest and salinities are highest, the most salt-tolerant plants are found, including pickleweed and quailbush. The salt desert shrub type generally gives way to sagebrush somewhere near the tops of the alluvial fans where the primary fault lines of the mountain range are situated. These upper soils are often gravelly and well-drained, and

are more likely to support spiny hopsage, bud sagebrush, and associated plants. The dominant grass species in the salt desert shrub type is Indian ricegrass, and to a lesser extent, needle-and-thread grass.

Value to Wildlife

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

Key Elements of Intermountain Cold Desert Shrub Habitat Important to Wildlife

SHRUBS – nesting structure, protection from predators, thermal cover

Loggerhead Shrike
Sage Sparrow
Brewer's Sparrow
Sage Thrasher

SANDY SOILS – burrowing, denning

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

ROCK FEATURES/GRAVELLY SOILS – denning, protection from predators

Great Basin collared lizard
dark kangaroo mouse

PREY POPULATIONS – feeding on species in this habitat

Bald Eagle

Ferruginous Hawk
greater short-horned lizard
desert horned lizard

Existing Environment

Habitat Conditions

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

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

Land Uses

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

Problems Facing the Species and Habitats

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

Predicted Climate Change Effects

Mixed Salt Desert

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

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

Greasewood

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

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

Possible Wildlife Responses to Climate Change

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

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

Taking Prescriptive Action

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

Priority Research Needs

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

Conservation Strategy

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

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

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

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

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

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

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

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

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

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

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

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

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

Action: Develop a nest occupancy survey for Ferruginous Hawk.

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

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

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

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

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

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

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

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

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

Partnerships

Land Management/Ownership

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

Existing partnerships, plans, and programs

Federal & State Agencies

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

Conservation Organizations

- The Nature Conservancy
- The Sierra Club

Bird Initiatives

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

Other Key Partners

- Counties
- Great Basin Bird Observatory
- Sportsmen's groups

Focal Areas

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

Mojave Warm Desert & Mixed Desert Scrub

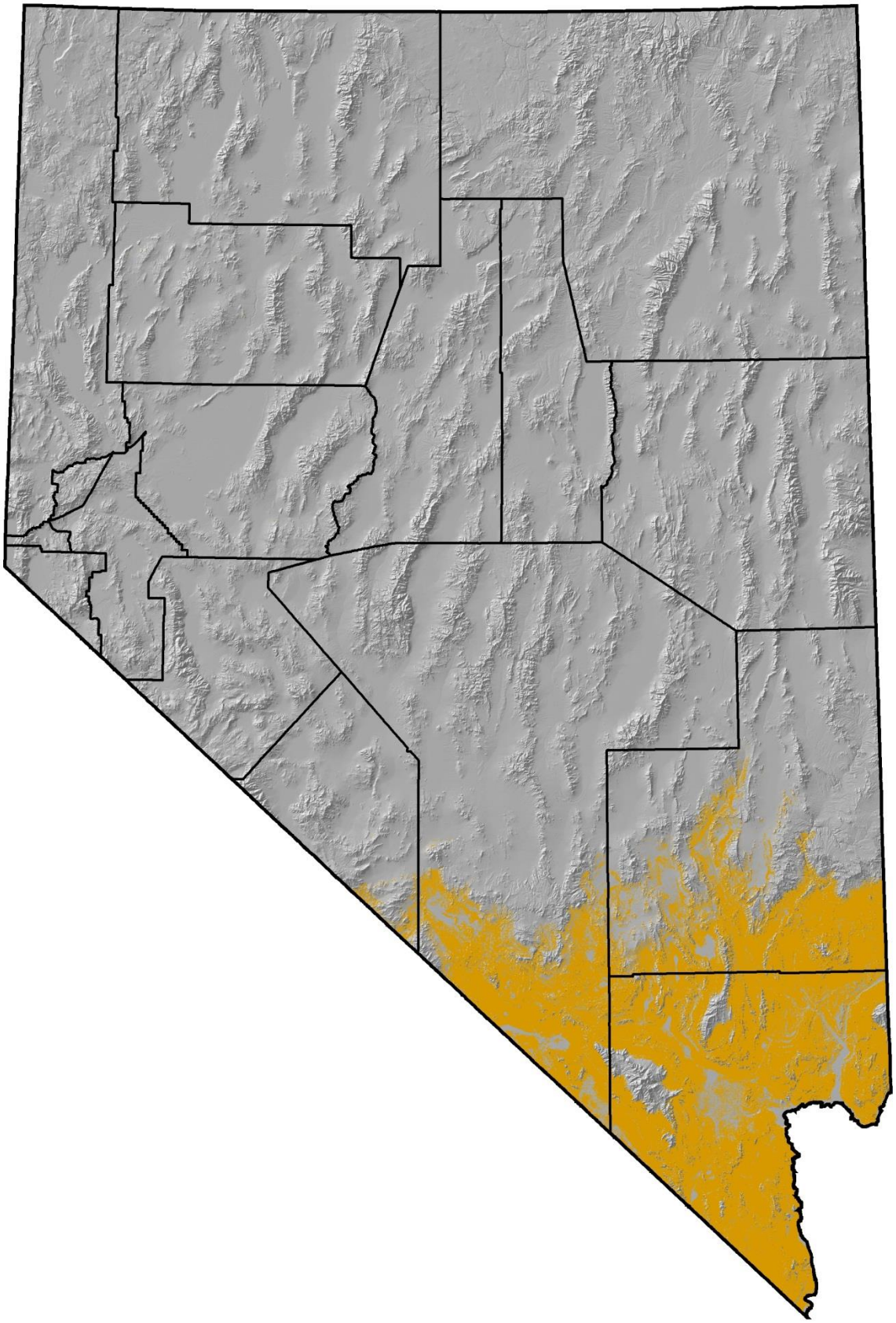

Figure 7. Distribution of Warm Desert & Mixed Desert Scrub in Nevada.

KEY HABITAT: MOJAVE WARM DESERT AND MIXED DESERT SCRUB

Things to Know….

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

Ecoregions

Southwest ReGAP 2005

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

Ecological Systems

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

Key Habitat Description

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

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

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

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

Value to Wildlife

Creosote Bush-White Bursage and Thermic Blackbrush

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

Mesic Blackbrush

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

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

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

western banded gecko
desert iguana
desert horned lizard
spotted leaf-nosed snake
Mojave shovel-nosed snake

ROCKS/CANYONS-nesting structure, protection from predators, thermal cover

Great Basin collared lizard
Chuckwalla
Gila monster
rosy boa
California leaf-nosed bat
desert bighorn sheep

WASH ECOTONE-foraging

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

SANDY SOILS – burrowing, denning

long-nosed leopard lizard
desert tortoise
desert pocket mouse
sidewinder
desert kangaroo rat
Burrowing Owl

YUCCA – nesting structure, protection from predators

desert night lizard
Bendire's Thrasher
Gilded Flicker

MESIC BLACKBRUSH-nesting structure, protection from predators

Black-chinned Sparrow

Existing Environment

Land Uses

- Urban/suburban development
- OHV recreation
- Military mission

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

Historic and Current Conditions

Creosote Bush-White Bursage

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

Thermic and Mesic Blackbrush

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

Problems Facing the Species and Habitats

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

Predicted Climate Change Effects

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

Creosote Bush-White Bursage

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

Thermic and Mesic Blackbrush

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

Possible Wildlife Responses to Climate Change

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

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

satisfactory to support horned lizards. The importance of other orders of insects, arachnids, etc. in the maintenance of wildlife populations in the Mojave must also be more precisely assessed and understood.

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

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

Taking Prescriptive Action

Thermic and Mesic Blackbrush

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

Creosote Bush-White Bursage

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

Priority Research Needs

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

Conservation Strategy

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Partnerships

Land Management/Ownership

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

Existing partnerships, plans, and programs

Multi-partner

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

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

Federal & State Agencies

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

Conservation Organizations

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

Other Key Partners

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

Focal Areas

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

Desert Tortoise Photo Courtesy of P. Conrad

Sagebrush

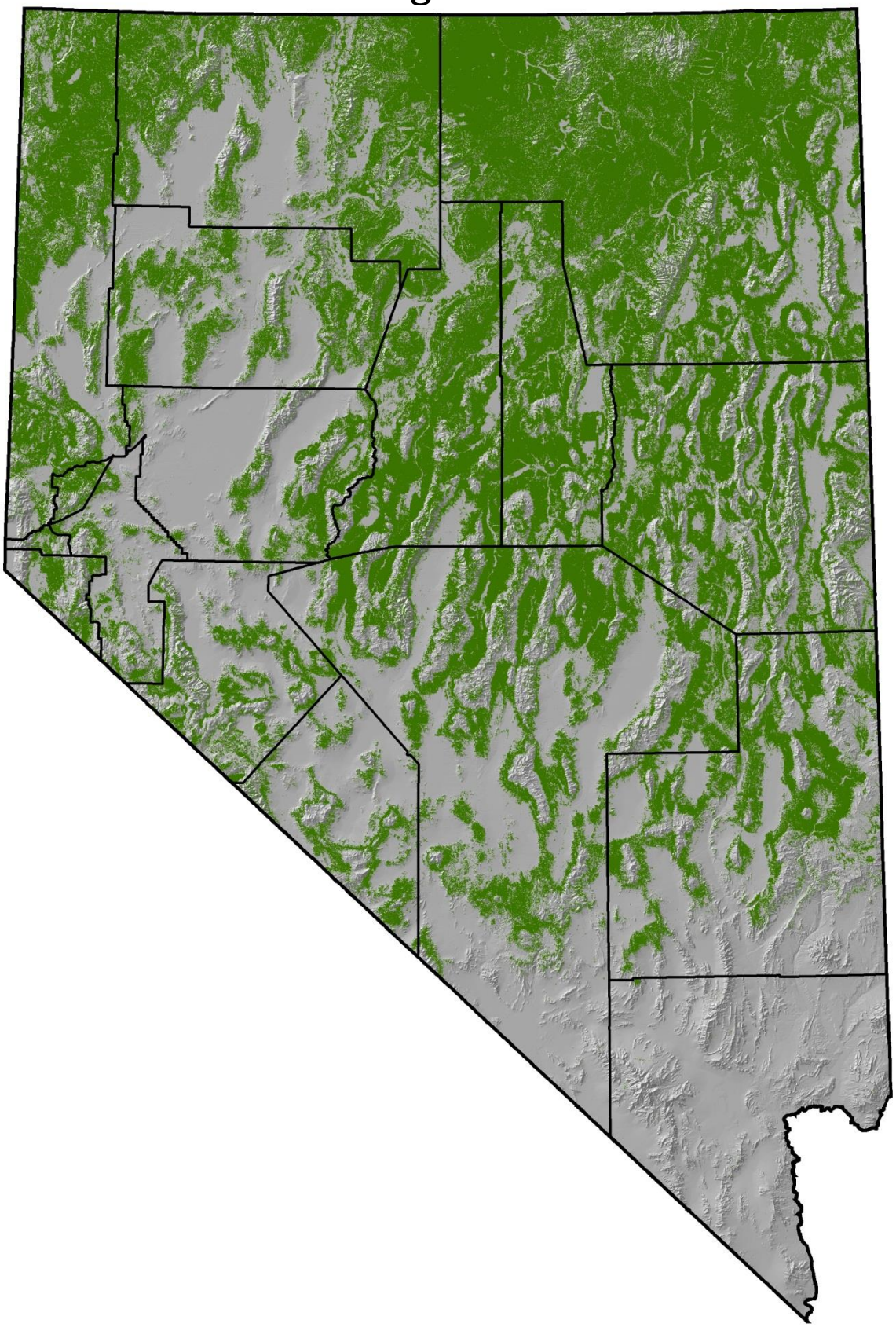

Figure 8. Distribution of Sagebrush in Nevada.

KEY HABITAT: SAGEBRUSH

Things to Know….

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

Ecoregions

Southwest ReGAP 2005

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

Ecological Systems

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

Key Habitat Description

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

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

The TNC Biophysical Settings involving sagebrush are described below:

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

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

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

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

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

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

Value to Wildlife

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

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

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

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

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

Key Elements of Sagebrush Habitat Important to Wildlife

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

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

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

mule deer

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

pygmy rabbit

GRASSES/FORBS – nesting cover, foraging

Greater Sage-Grouse
Columbian Sharp-tailed Grouse

sagebrush vole
Merriam's shrew
Preble's shrew

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

MESIC SITES – foraging
Inyo shrew
Sage Thrasher

WOODLAND/ROCK ECOTONE – nesting, foraging
Ferruginous Hawk

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

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

Existing Environment

Land Uses

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

Habitat Conditions

Much of the basin big sagebrush and Wyoming big sagebrush range in Nevada currently lacks understory of

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

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

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

Problems Facing the Species and Habitats

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

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

Predicted Climate Change Effects

Big Sagebrush Steppe

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

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

Big Sagebrush Upland

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

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

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

Low-Black Sagebrush

The Low-Black Sagebrush BpS occurs in all 13 regions evaluated by TNC. In reference condition, Low-Black Sagebrush should exhibit 15-20% in the early class, 40-50% in the mid-open class, and 30-40% in the late-open/closed classes. Low-black sagebrush in current condition exhibits a healthy 40 to 75% in the mid-open

class, but early and late classes are invaded by annual grasses with some tree encroachment occurring on the eastern and western borders of the state.

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

Low Sagebrush Steppe

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

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

Montane Sagebrush Steppe Mountain

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

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

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

Wyoming Big Sage

Wyoming Big Sage occurs in all the evaluated regions except the Mojave. Currently the type is significantly departed from reference conditions in all regions except the Owyhee Desert, where only one percent was classified in any uncharacteristic class (Appendix C). With respect to the distribution of the type between

characteristic classes in the Owyhee, there is no early class and significant invasion by annual grass or juniper is not yet occurring. All other regions are currently exhibiting greater than 50% of their acreage of Wyoming Big Sage in uncharacteristic classes, some as high as 90%. For most regions, the bulk of the U-class acreage occurs in the tree-annual grass class and in the Elko region most of the U-class acreage occurs in rabbitbrush – both rather unfriendly habitats to sagebrush-associated wildlife species. Four regions (Eastern Sierra, Eureka, Humboldt, and Owyhee Desert) were predicted to increase in U-class percentage over 10% in 50 years with climate change. Only Owyhee, Elko, and Eastern Sierra will remain under 60% transitioned to U-classes in 50 years.

Possible Wildlife Responses to Climate Change

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

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

An evaluation of the relative values of the different classes of sagebrush leads to the identification of uncharacteristic classes that will have definite impacts on wildlife's ability to stay on the landscape. For the purposes of this analysis, we have identified the following classes as unsatisfactory to sagebrush-associated

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

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

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

Taking Prescriptive Action

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

Priority Research and Monitoring Needs

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

the shrub component, species response to rabbitbrush dominance, and incremental changes in annual grass dominance and pinyon/juniper encroachment.

- Develop a survey/inventory and occupancy/trend program for pygmy rabbit and Ferruginous Hawk.
- Continue occupancy/trend survey for mice, voles, and shrews of Conservation Priority.

Conservation Strategy

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

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

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

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

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

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

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

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

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

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

Action: Determine project sideboards (e.g., protection of adjacent mountain mahogany stands; protection of identified high-quality pinyon-juniper wildlife habitats); apply pinyon-juniper treatment using methods posing

the least potential threat and greater potential benefit to adjacent habitats at-risk (e.g. those described above).

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Partnerships

Land Management/Ownership

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

Existing partnerships, plans, and programs

Multi-partner

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

Federal & State Agencies

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

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

Conservation Organizations

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

Sportsmen's Organizations

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

Bird Initiatives

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

Other Key Partners

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

Focal Areas

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