Figure 9. Distribution of Lower Montane Woodlands & Chaparral Habitat type in Nevada.
**Key Habitat: Lower Montane Woodlands and Chaparral**

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

**Ecoregions**

*Southwest ReGAP 2005*

<table>
<thead>
<tr>
<th>Ecoregion</th>
<th>hectares</th>
<th>acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Great Basin</td>
<td>1,895,051</td>
<td>4,679,139</td>
</tr>
<tr>
<td>Columbia</td>
<td>93,817</td>
<td>231,647</td>
</tr>
<tr>
<td>Mojave</td>
<td>173,980</td>
<td>429,580</td>
</tr>
<tr>
<td>Sierra Nevada</td>
<td>3,859</td>
<td>9,529</td>
</tr>
<tr>
<td>Total</td>
<td>2,166,707</td>
<td>5,349,895</td>
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**Ecological Systems**

<table>
<thead>
<tr>
<th>TNC Biophysical Setting</th>
<th>SWReGAP Ecological Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinyon-Juniper</td>
<td>S040 Great Basin Pinyon-Juniper Woodland</td>
</tr>
<tr>
<td>Mountain Shrub</td>
<td>S046 Rocky Mountain Gambel Oak-Mixed Montane Shrubland</td>
</tr>
<tr>
<td>Curl-leaf Mountain Mahogany</td>
<td>S050 Intermountain Basins Mountain Mahogany Woodland and Shrubland</td>
</tr>
<tr>
<td>Chaparral</td>
<td>S053 Great Basin Semi-Desert Chaparral</td>
</tr>
<tr>
<td>Juniper Savanna</td>
<td>S075 Intermountain Basins Juniper Savanna</td>
</tr>
</tbody>
</table>

**Key Habitat Description**

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

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

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

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

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

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

**Value to Wildlife**

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

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

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

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

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

**WOODLAND NON-SPECIFIC**

**MATURE STAND/SNAGS/CAVITY** – nesting/roosting structure, protection from predators, dying trees provide insect prey base
- long-eared myotis
- Allen’s big-eared bat
- western small-footed myotis
- fringed myotis
- little brown bat

**ROCKS/MINES** – nesting, roosting, protection from predators
- Gray-crowned Rosy-Finch
- Black Rosy-Finch
- Sonoran Mountain kingsnake
- Great Basin collared lizard
- Panamint alligator lizard

**AERIAL FEEDERS/MIGRANTS** – species foraging in this habitat (e.g., aerial insectivores, bird species during migration)
- Townsend’s big-eared bat
- spotted bat

**TERRESTRIAL ARTHROPOD FEEDERS**
- Inyo shrew
- Merriam’s shrew
- greater short-horned lizard
- pygmy short-horned lizard

**SHRUBS** – shrub feeders, protection from predators, thermal cover, nesting structure
- Mountain Quail
- Dusky Grouse
- Sooty Grouse
- Loggerhead Shrike
- Black-chinned Sparrow
- bighorn sheep
- mule deer
- shadow (Allen’s) chipmunk
- Palmer’s chipmunk
- Sierra Nevada snowshoe hare
- bighorn sheep
- mule deer
- Palmer’s chipmunk

**RIPARIAN ECOTONE** – foraging, nesting
- Virginia’s Warbler
NUFF/LITTER
Western red-tailed skink
Western threadsnake

PINYON-JUNIPER

LARGE OLD TREES – nesting structure
Ferruginous Hawk

CON-E-BEARING STANDS – foraging
Pinyon Jay
Cassin’s Finch

Existing Environment

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

Habitat Conditions

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

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

Fire suppression working in concert with overutilization by ungulates has likely contributed to the progression of mountain shrub stands towards dominance by pinyon and juniper in many areas of its occurrence in Nevada.
Tree encroachment will further accelerate the decline of the shrub community because of increased shading and competition for soil moisture.

**Problems Facing the Species and Habitats**

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

**Predicted Effects of Climate Change**

**Pinyon-Juniper**

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

**Juniper Savanna**

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

**Mountain Mahogany**

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

Mountain Shrub

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

Chaparral

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

Possible Wildlife Responses to Climate Change

Pinyon-Juniper

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

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

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

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

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

**Juniper Savanna**

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

**Mountain Mahogany**

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

**Mountain Shrub**

The percent loss to conversion of the mountain shrub BpS varies considerably among regions, with the eastern border regions (Elko, Calcareous, and Clover) especially hard-hit (18 to 28% loss). The Mojave region registered the second highest total acreage lost, but because the Mojave region was by far the region with the greatest total acreage of the type, the loss amounted to only five percent of the current mountain shrub total. Twenty percent losses in the eastern regions would be expected to negatively impact mule deer production and fawn survival as mountain shrub communities in those regions are so predominantly populated by summering mule deer does. In addition to this loss, tree-encroachment by pinyon and juniper of mountain shrub communities results in suppression of browse productivity that comprises a critical part of deer summer range (NDOW, 2011).
The importance of the habitat dependency is so great that mule deer population numbers in those regions might be expected to reach as high as 20% — a “one-to-one” ratio indicating that mule deer populations are generally considered to be at carrying capacity in current conditions (NDOW, 2011). The Nevada Bird Count climate change analysis suggested that the 13% loss of mountain shrub acreage to conversion statewide would contribute toward overall displacement of Black-chinned Sparrows, Virginia’s Warblers, Pinyon Jays, and Scott’s Orioles throughout their ranges in Nevada.

Chaparral

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

Taking Prescriptive Action

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

Priority Research Needs

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

Priority Monitoring Needs

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

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

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

“ecological health” – not more than 20% in uncharacteristic classes; characteristic classes redistributed to closer approximate reference conditions.

**Action:** Map mountain shrub stands throughout the state at a scale finer than SWReGAP.

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

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

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

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

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

**Objective:** Increase Mountain Quail distribution 10% by 2022.

“distribution” – distinct geographic locations where Mountain Quail occur.

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

**Action:** Supplement Mountain Quail introductions and augmentations with well-scouted and designed guzzlers where water availability might otherwise be restrictive.
Objective: Maintain Sooty Grouse and Dusky Grouse at current distribution through 2022.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Action: Manage landscapes adjacent to healthy mountain mahogany stands to minimize the threat of wildfire spreading to reproductive stands.
Objective: Maintain populations of other birds of conservation priority at stable or increasing trend and distribution concomitant with climate change habitat shifts through 2022.

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

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

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

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

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

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

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

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

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

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

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

Partnerships

Land Management/Ownership

<table>
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</table>
Existing partnerships, plans, and programs

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

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

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

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

**Focal Areas**
- Buffalo Hills
- Butte Valley
- Carson Range
- Cave Valley
- Cherry Creek Range
- Clan Alpine Mountains
- Crooks Lake and plateau
- Goshute Mountains
- Granite Range
- Hays Canyon Range
- Madelin Mesa
- Pancake Range
- Pequop Mountains
- Roberts Creek Mountains
- Ruby Mountains
- Santa Rosa Range
- Sheldon NWR
- Silver Peak Range
- Simpson Park Range
- Snake Range
- Snake Valley
- Spring Mountains
- Spring Valley
- Spruce Mountain
- Steptoe Valley
- Toiyabe Range
- Toquima Range
- White River Valley
- White Rock Mountains
- Wassuk Range
Figure 10. Distribution of Intermountain Coniferous Forests and Woodlands in Nevada.
KEY HABITAT: INTERMOUNTAIN CONIFEROUS FORESTS AND WOODLANDS

Things to Know....

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

Ecoregions

_Southwest ReGAP 2005_

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Ecological Systems

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<td>Ponderosa Pine</td>
<td>S036 Rocky Mountain Ponderosa Pine Woodland</td>
</tr>
<tr>
<td>Spruce-Fir</td>
<td>S028 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland</td>
</tr>
<tr>
<td></td>
<td>S030 Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland</td>
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Key Habitat Description

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

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

Value to Wildlife

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

Mature or old growth conifer forests are also valuable to wildlife because they provide an abundance of insect infected snags or dying trees. Trees with heart rot provide the essential substrate for cavity excavation which is important for wildlife nesting or denning, and dying trees provide an insect prey base for foraging. Some species are tied to temporal disturbances in conifer habitats (e.g., Lewis’s Woodpecker), because they require the resulting insect outbreaks (Leonard, 2001).
Although higher elevation conifer woodlands do not provide large patches of “forest” for wildlife, these communities are still important. Wildlife species feed on limber and bristlecone pine seeds, and the trees provide structure in an otherwise sparsely vegetated environment. Conversely, limber pine communities benefit from wildlife since its natural regeneration appears to be closely associated with caching of the large wingless seeds, primarily by Clark’s nutcracker (NatureServe, 2004).

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

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

- Northern Goshawk
- Flammulated Owl
- Palmer’s chipmunk

**MID-STORY STRUCTURE** – nesting structure, foraging

- hoary bat
- Humboldt yellow-pine chipmunk

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

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

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

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

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

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

**MESIC MICROsites** – foraging

- montane shrew
- northern rubber boa
Existing Environment

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

**Habitat Conditions**

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

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

**Problems Facing the Species and Habitats**

Natural processes that have shaped the development of conifer forests and woodlands in Nevada include fire, insects, and storms. Natural processes in conifer forests and woodlands have been inhibited by modern forestry practices, including fire suppression, salvage logging (cutting of burned trees), suppression logging (cutting of insect infested trees), and alteration of natural fire intensity. A long history of fire suppression has facilitated blister rust and insect outbreaks in subalpine fir, limber, and whitebark pine communities in Nevada.
Many wildlife species are restricted to forests of commercially valuable trees, and past wood products extraction may have reduced habitat suitability with the removal of large diameter trees. Conifer forests and woodlands in Nevada do not provide many viable commercial opportunities for timber extraction, however, where wood products extraction activities do occur, the most visible impact is loss of nest cavities. At present, the most immediate human threat to species in these habitats may be cutting (authorized and unauthorized) of dead trees for firewood. Extirpation of primary cavity excavators by introduced European Starlings is another potential threat to cavity nesting species. The recruitment of snags (dead trees or branches with good potential for holes) and health of woodpecker populations is essential to conservation of cavity-nesting species (McCallum, 1994).

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

**Predicted Climate Change Effects**

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

**Mixed Conifer**

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

**Limber/Bristlecone Pine**

The limber/bristlecone pine BpS was recorded in nine of 12 regions. For regions with over 1,000 acres, climate change modeling projected significant increases in acreage in the Calcareous (six percent) and Elko (16%) regions and decreases in the Mojave and Toiyabe regions (two percent each) and the Eureka region (five percent). The Black Rock region, where almost 2,000 acres were recorded, underwent no net change in acreage. No uncharacteristic classes were identified for this BpS. Current seral stage distributions varied considerably among regions. Climate change modeling indicated that regions would progress into three general groupings —
the Black Rock and Elko regions would progress toward a predominance in the mid-open class while the Calcareous, Eureka, and Toiyabe regions would progress toward slightly greater predominance in the late-open class. The Mojave region exhibited the current conditions closest to reference and projected to transition very little after 50 years of climate change.

**Ponderosa Pine**

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

**Spruce/Fir**

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

**Possible Wildlife Responses to Climate Change**

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

**Mixed Conifer**

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

**Limber/Bristlecone Pine**

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

**Ponderosa Pine**

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

**Spruce/Fir**

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

Taking Prescriptive Action

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

Priority Research Needs

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

Conservation Strategy

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

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

*Action:* Perform habitat suitability assessments for coniferous forest stands based on prioritization by presence of key species with restricted ranges, elevated risk, or key stewardship management responsibility (for Nevada).
**Action:** Proactively manage conifer communities that need fire through wild and prescribed fires with particular focus on white fir, mixed aspen-conifer, and ponderosa pine communities.

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

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

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

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

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

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

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

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

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

**Objective:** Increase Mountain Quail distribution 10% by 2022.

“distribution” – distinct geographic locations where Mountain Quail occur.

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

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

“other birds of conservation priority” – Lewis’s Woodpecker; Olive-sided Flycatcher; Cassin’s Finch

“stable or increasing trend” – as measured by USGS Breeding Bird Survey or Nevada Bird Count
**Action:** Support volunteer staffing of USGS BBS routes and Nevada Bird Count transects, including NDOW staff participation.

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

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

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

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

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

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

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

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

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

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

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

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

**Action:** Include an array of Intermountain coniferous forest and woodland sites in a statewide surveillance survey for reptiles.
**Action:** Initiate species investigations of Western red-tailed skink and northern rubber boa for the purpose of developing a rough understanding of range, distribution, relative densities, habitat preferences, and management needs.

**Partnerships**

**Land Management/Ownership**

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**Existing partnerships, plans, and programs**

**Multi-partner**
- Spring Mountains National Recreation Area Conservation Agreement
- Forest Stewardship Program

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

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

**Bird Initiatives**
- Partners In Flight – North American Land Bird Conservation Plan
- Nevada Partners in Flight – Nevada Bird Conservation Plan
Other Key Partners

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

Focal Areas

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

Flammulated Owl

Photo Courtesy of B. Goodman
Figure 11. Distribution of Sierra Coniferous Forests and Woodlands in Nevada.
**KEY HABITAT: SIERRA CONIFEROUS FORESTS AND WOODLANDS**

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

**Ecoregions**

*Southwest ReGAP 2005*

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<th>Ecoregion</th>
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<tr>
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<td>Sierra Nevada</td>
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**Ecological Systems**

<table>
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<th>TNC Biophysical Setting</th>
<th>SWReGAP Ecological Systems</th>
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<tr>
<td>Subalpine Woodland</td>
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</tr>
<tr>
<td>Mixed Conifer</td>
<td>S033 Mediterranean California Dry-Mesic Mixed Conifer Forest</td>
</tr>
<tr>
<td></td>
<td>and Woodland</td>
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<tr>
<td>Red Fir</td>
<td>S121 Mediterranean California Red Fir Forest and Woodland</td>
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<td>Lodgepole Pine Dry</td>
<td>S122 Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland</td>
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<td>Lodgepole Pine Wet</td>
<td>S122 Sierra Nevada Subalpine Lodgepole Pine forest and Woodland</td>
</tr>
<tr>
<td>Jeffrey Pine</td>
<td>S123 Mediterranean California Ponderosa-Jeffrey Pine Forest and Woodland</td>
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</table>

**Key Habitat Description**

Sierra coniferous forests and woodlands are comprised of a diverse assemblage of ecological systems that range from the Sierra Nevada foothills up to ridges and rocky slopes around timberline (2,700 meters [8,200 feet]). Mixed conifer forests and woodlands typify the lower elevation systems. These forested systems form closed, multilayered canopies with shrubs present in the understory where openings occur. Common conifer species of the mixed conifer forest and woodland ecological system include white fir, Jeffrey pine, incense cedar,
ponderosa pine, and sugar pine (NatureServe, 2004). White fir tends to be the most ubiquitous species since it is shade tolerant and has the ability to survive long periods of suppression in brush fields.

Jeffrey and ponderosa pine forests and woodlands are found on warm, xeric sites in the Sierra Nevada foothills and mountains and are generally segregated by soil fertility and temperature regimes (NatureServe, 2004). Jeffrey pine is the dominant species on the Nevada side of the Sierra Nevada (often called “eastern yellow pine”) because it is better adapted to xeric sites at lower elevations, on south-facing slopes, or on well-drained soils. Ponderosa pine is more frequent on the California side of the Sierra Nevada but can be found in Nevada on moist and productive soils at lower to moderate elevations. Western white pine is frequently associated with Jeffrey pine, sometimes co-dominant, on the western slope of the Carson Range. Dominant shrub layer species include antelope bitterbrush, rabbitbrush, and sagebrush at lower elevations and squaw currant, snowbush, and greenleaf manzanita at all elevations. Common herbaceous species include squirreltail, blue wildrye, slender hairgrass, western needle-grass, woolly wyethia, and pennyroyal (Deukmejian et al., 1988).

Moving up the slope, conifer forest and woodlands include lodgepole pine, red fir, and the subalpine conifer systems. Red fir conifer forests and woodlands are located in higher elevations, above mixed conifer forest, and heavy snowpack is a major source of soil moisture throughout the growing season. Forest stand structure is typified by even-aged red fir trees with very few other plant species present in any other layer. Western white pine is often dominant to co-dominant with red fir on the west slopes of the Carson Range.

Another conifer system, lodgepole pine, typically forms stands of similarly sized trees, and is widespread in glacial basins at upper montane to subalpine elevations of the central and northern Sierra Nevada (NatureServe, 2004). Lodgepole pine occurs in two very different biophysical settings in the Sierra Nevada – “dry” and “wet.” The dry lodgepole BpS occurs on upper montane and subalpine dry sites on benches and moderate slopes in nutrient poor granitic or pumice soils. Individual trees can reach large diameters and stands are often woodlands. Forest understory is typically sparse with few shrubs and low-to-moderate herbaceous cover. The Carson Range offers many examples of this dominant type of lodgepole pine. Wet cold lodgepole pine occurs on upper montane sites usually on gently rolling lower slopes and drainage bottoms where soils might be water-logged. This BpS resembles most the Rocky Mountain lodgepole pine BpS. Sites are moist to wet and more productive than dry cool subalpine lodgepole. Fuels are composed of a matrix of herbaceous vegetation and pine debris. The understory is diverse with graminoids and forbs (cover >50%). Tree cover is generally moderate to dense and individual trees are rarely of large diameter. Few other species are co-dominants with lodgepole pine but occasional associates include aspen and mountain hemlock. The understory component of lodgepole pine forests is usually sparse consisting of scattered shrubs and herbs, or a rich herbaceous layer at meadow margins (Deukmejian et al., 1988). A few good examples of the wet type are found in Little Valley west of Washoe Valley.

Northern Pacific mesic subalpine woodlands occur on ridges and rocky slopes around timberline on concave or mesic slopes in areas with long-lasting snowpack and better soil development than other drier and more exposed subalpine woodlands. Characteristic species include mountain hemlock, red fir, whitebark pine, and juniper, as well as patches of grasses, sedges, and forbs grading into adjacent meadows (NatureServe, 2004).

Value to Wildlife

Wildlife depend on a variety of features for foraging, roosting, and nesting provided by conifer forests and woodlands that include mesic microsites, mid-story structure, and mature canopy. Forest-associated bat species (e.g., long-eared myotis) day-roost in hollow trees or under exfoliating bark (Bradley et al., 2004). In addition,
some wildlife in conifer forests and woodlands primarily make use of the conifer-riparian ecotone because of the diversity of plant growth and edge conditions in these areas (Hill, 1995). Young, early successional conifer forests provide dense foliage and vegetation for species that prefer understory cover, particularly small mammals. These species are tied to forage access and protection from predators. Old growth forests can also provide this structure since they have treefall and windthrow gaps in the canopy, large downed logs, rotting woody material, and tree seedling establishment on logs or on mineral soils unearthed in root balls (NatureServe, 2004). Openings in the dominant canopy facilitate vegetation regeneration on the forest floor which provides favorable habitat for the species utilizing understory cover. Other wildlife species respond to the prey populations that inhabit the forest understory (e.g., Northern Goshawk). Typically these species are wide-ranging, and their habitat use is driven more by prey availability than the actual habitat features.

Natural disturbances that plague many western second growth stands, including insect epidemics, disease outbreaks, and fire, are less likely to have catastrophic consequences in Sierra Nevada old growth conifer forests and woodlands. Old growth forests and woodlands provide structural complexity (many trees in different diameter classes), high canopy closure, and downed wood, and some wildlife species require old growth forests for various portions of their life histories. Priority species requiring old growth include American marten, whose optimum habitat elements appear to be mature old growth spruce-fir communities with greater than 30% canopy cover, and a well-established understory of fallen logs and stumps and understory vegetation supporting small mammal prey (Clark et al., 1987); California Spotted Owls, requiring large trees (greater than 90 centimeters diameter at breast height) for foraging and nesting (Gutierrez et al., 1995); and, White-headed Woodpeckers, requiring abundant mature pines (with large cones and abundant seed production), a relatively open canopy (50 to 70%), and snag and stump availability for nest cavities (Garrett et al., 1996).

The Sierra coniferous forest remnants that harbor wildlife species uniquely adapted to live in old growth habitats are important because many of these species are found nowhere else in Nevada. Mature or old growth conifer forests are also valuable to wildlife because they provide an abundance of insect-infected snags or dying trees. Trees with heart rot provide the essential substrate for cavity excavation which is important for wildlife nesting, and dying trees provide an insect prey base for foraging. Northern flying squirrels nest in red fir with mature witch’s broom growths and large DBH trees with cavities.

Sierra coniferous forests and woodlands also provide foraging habitat for aerial feeders (e.g., bats). Some species are tied to temporal disturbances in these habitats (e.g., Lewis’s Woodpecker), because they require the resulting insect outbreaks (Leonard, 2001). Although Sierra coniferous forests and woodlands comprise only a small portion of Nevada’s key habitats, they are valuable for wildlife and play an essential role in conservation planning for the state’s wildlife.

**Key Elements of Sierra Coniferous Forests and Woodlands Habitat Important to Wildlife**

**OVERSTORY CANOPY** – nesting structure, roosting, protection from predators
- Sooty Grouse
- Cassin’s Finch
- hoary bat
- silver-haired bat
- long-eared myotis
SHRUB AND HERBACEOUS COVER – protection from predators, foraging, thermal cover
   Mountain Quail
   Sierra Nevada snowshoe hare
   montane shrew
   mule deer
   Sierra alligator lizard

OLD GROWTH – mature structure for nesting and roosting, denning (downed wood), burrowing (deep soils), foraging (downed wood and understory vegetation supports small mammal populations), snags, cavities
   Bald Eagle
   California Spotted Owl
   Northern Goshawk
   White-headed Woodpecker
   Flammulated Owl
   Olive-sided Flycatcher
   northern flying squirrel
   shadow (Allen’s) chipmunk
   long-eared myotis
   American marten

DISTURBANCE – fire or insect outbreaks create suitable conditions for foraging (increased insects) and nesting (substrate for cavity excavation)
   Lewis’s Woodpecker

RIPARIAN/WET MEADOW ECOTONE – foraging (diversity of plant growth), protection from predators and nesting (edge conditions resulting in dense cover)
   mountain pocket gopher
   spotted bat
   little brown bat
   Aplodontia

Existing Environment

Land Uses
   • Urban/suburban development
   • Motorized recreation – snowmobiles, OHVs
   • Non-motorized recreation – hiking, camping, back country skiing
   • Recreation development – ski areas, snow parks, developed campgrounds and day-use areas
   • Species harvest

Habitat Conditions

The Comstock mining era had a profound effect on the Sierra coniferous forests and woodlands with wood being extracted for building, mining timbers, and fuel wood for domestic purposes, and power mills, crushing ore, and for hoisting works in the mines. Between 1860 and 1875 the Carson Range was completely cut over and the timber of the Tahoe Basin began to be harvested. During this time, little thought was given to stand improvement, species diversity, or leaving a seed source for future stands. As a result, most old growth conifer forest habitat in the Carson Range was eliminated, and the landscape is now dominated by second growth
conifer forests. These second growth forests contain trees all relatively similar in age and the white fir component is much greater than pre-settlement forest. Fire suppression beginning in the 1920s fostered the retention of an unnatural proportion of white fir in the forest community, and dead woody material has accumulated to dangerously high levels on the more productive sites. The drought of the early 1990s coupled with epidemic insect infestations resulted in mortality of most white fir and Jeffrey pine that was under 120 years-old. This combination of factors has contributed to the current cycle of rapid stand collapse and regrowth, which replaced a cycle of gradual changes.

Problems Facing the Species and Habitats

The altered fire regime of Sierra coniferous forests and woodlands is the most daunting challenge wildlife species and these habitats are currently facing. Many years of fire suppression have resulted in abnormally high fuel levels. Combined with the conifer mortality resulting from fir engraver beetles (white fir) and bark beetles (lodgepole and Jeffrey pine) and increases of the highly flammable invasive cheatgrass, particularly at lower elevations, restoring equilibrium to this habitat will take very proactive management with no guarantee that valuable wildlife habitat won’t be lost to future catastrophic events. Another challenge to modifying the current practice of high fire suppression is the proximity of this habitat to the urban interface and resultant concerns for human safety and potential economic loss.

Sierra coniferous forests and woodlands experience significant pressure from urban and suburban development. In fact, the undeveloped area of the Sierra Nevada phytographic region was by far the smallest of all 14 Nevada regions because urban areas and Lake Tahoe represent >50% of an already small total area. This meant that estimates of ecological departures for the Sierra Nevada’s region ecological systems, especially its forest types, could be inaccurate due to their small size. Development has and will continue to result in permanent habitat loss or conversion, inflict direct mortality, and fragment wildlife habitat if conservation of these forest habitats and their associated species is not incorporated into the planning process. An increasing human population is coupled with the need for infrastructure (e.g., road, utility corridors) that can serve as a conduit for invasive species such as cheatgrass, and result in additional forest fragmentation. The Sierra Nevada provides multiple recreation opportunities that are sources of stress for wildlife and their habitats, including non-motorized (e.g., hiking, back-country skiing) and motorized (e.g., OHVs, snowmobiles) recreational pursuits. OHV use in the area is mostly concentrated on Peavine Mountain. Ski areas, snow parks, and developed day-use areas and campgrounds also facilitate increased disturbance to wildlife and alter the habitat through the removal of vegetation and soil compaction.

Although current forestry practices are designed to address stand health, conifer forests and woodlands in the Sierra Nevada are still recovering from historic forestry practices during the Comstock era. Wildlife species and their habitats in the Carson Range are subject to increases in noxious weeds, habitat conversion, fragmentation, and population isolation due to the pressures of urbanization. For example, mule deer migration corridors are intersected by major highways and urban development, resulting in increased vehicle collision mortalities and restricted movement of mule deer in and out of the Carson Range. Consequently, the Carson Range, like other mountain ranges in Nevada, is becoming isolated from adjacent landscapes. This circumstance may ultimately result in decreased genetic variability of populations and increased risk of localized species extirpations as a result of environmental stochastic events.

Predicted Effects of Climate Change

The Nature Conservancy climate change analysis did not include the portion of the Tahoe Basin that occurs in Nevada because it had been analyzed in another recent report – “Forecasting the Response of Terrestrial
Habitats to Climate Change in the Northern Sierra: Climate Change Adaptation Strategies for the Northern Sierra Partnership” (TNC, 2011), hereafter named in this document “The Northern Sierra Report.” While ecological condition assessments for the forest types unique to the Nevada Tahoe Basin cannot be specifically separated out of the Northern Sierra Report, they can be discussed in terms comprehensive to the Northern Sierra Nevada and applied to Nevada’s climate change predictive analysis in an extrapolated manner. The hypotheses of climate change proposed in this report were first formulated in TNC’s Northern Sierra Report.

For the purpose of this discussion, we included all coniferous forest acreages in the Eastern Sierra region even though we knew there were a few stands outside the Sierra Nevada proper. We used the Northern Sierra Report to gain insight into the coniferous forest types not inventoried in the Eastern Sierra region (Lodgepole Pine, Red Fir, Subalpine Woodland).

**Mixed Conifer**

Currently, the mixed conifer BpS in the Eastern Sierra region predominantly exists in the early stage (less than 50 years old – 67%), with 25% in the mid-successional stages and a serious deficiency in the late classes. Modeling results for 50 years of climate change predicted a significant shift from the early class to mid-successional stages (predominantly mid-open), and a doubling of percentage in late classes (7 to 16%), but late classes would still only represent a little over one-third the total found in reference condition. This could likely reflect the phenomenon of this type having been heavily harvested over a relatively short period of time (Comstock logging period), sending the BpS into even-aged stand cycling vulnerable to heavy insect infestation and catastrophic fire prior to reaching maturity. Also important is the prediction that the mixed conifer BpS would increase at the expense of other BpS’s, i.e., mixed conifers, especially white fir, benefit from climate change because their fast growing species are fertilized by increasing CO₂.

**Jeffrey Pine**

Similar to mixed conifer, the Jeffrey pine BpS currently exists in the early and mid-successional stages. In reference condition, 50% of the type should be in late-open class, but currently only 13% exists in the late-open class. Results of climate change modeling indicated significant transitioning from the early class to the mid-successional classes and a slight increase in late classes with transitioning from late-open to late-closed. Uncharacteristic classes with non-native annual grasses (cheatgrass) were also projected to increase from six percent to a total of 14%, therefore continuing a trend already observed by US Forest Service field staff (personal communication, 2011).

**Red Fir**

Two biophysical settings involving red fir were identified in the Northern Sierra Report – Red Fir-Western White Pine and Red Fir-White Fir. The red fir-western white pine type is the most common in the Carson Range. Neither type registered in the Eastern Sierra region inventory. In the Northern Sierra Report, the two red fir types were characterized as predominant in the mid-successional stages (68 and 72%) and deficient in the late classes 20 and 25% in the inventory; 56% reference). No uncharacteristic classes were identified in the report. Both red fir types were projected to improve in ecological departure with 50 years of climate change. While the actual range of percentages for the climate change projection were not available from the Northern Sierra Report, it can be assumed that transitioning from mid-successional to late-successional stages occurred. Some conversion to other types was predicted – seven percent for red fir-western white pine and two percent for red fir-white fir. Also significant, the red fir BpS is predicted to gain area at the expense of subalpine conifers while losing ground to mixed conifers and chaparral.
Lodgepole Pine

Neither dry nor wet lodgepole BpS registered in the Eastern Sierra region inventory, but both are present on the Carson Range. The Northern Sierra Report indicated that both lodgepole communities were currently uncharacteristically heavy in late successional stages. Climate change modeling indicated that dry lodgepole would continue to age, transitioning from mid-open to late-open and from late-open to late-closed with a seven percent conversion to red fir and mixed conifer. Specific transitioning results for wet lodgepole were not made available through the report because this vegetation type is much less abundant in the Carson Range.

Subalpine Woodland

In Nevada, the subalpine woodland BpS is predominantly represented by whitebark pine and mountain hemlock, and none registered in the Eastern Sierra region inventory although the type is present on the Carson Range, so the following inferences come from the Northern Sierra Report. The subalpine woodland BpS currently exists fairly close to reference condition. Within mid-successional stages, there is a preponderance of mid-open over mid-closed and within the late classes there is a preponderance of late-open over late-closed, but the two-class totals for each of those stages were fairly close to reference. No uncharacteristic classes were identified in the report. Ecological departure increased slightly with 50 years of climate change (modeled), but remained in what is considered to be “good” condition. The nature of the increase in ecological departure (transitioning between classes) could not be derived from the report. Among all Sierra Nevada conifer BpS’s, the subalpine conifer BpS is expected to experience the greatest loss of area to conversion by >70%. TNC’s report also indicated that two important elevational refugia for the subalpine conifer BpS are Mt. Rose and the Carson-Iceberg Wilderness (California).

Possible Wildlife Responses to Climate Change

Mixed Conifer

All priority species were expected to be encountered in mixed conifer with the partial exception of Lewis’s Woodpecker which is primarily associated with open or burned Jeffrey Pine and vacates pine forest when it is invaded by closed stands of mixed conifer. Climate change modeling projected a large conversion of other conifer forest types into the mixed conifer BpS and natural transitioning from early to mid-closed and a doubling of late-successional classes still significantly deficient from reference conditions. The increase in mid-successional stages was expected to benefit Sierra Nevada snowshoe hares which utilize the mixed sapling-shrub stands for day loafing adjacent to their riparian feeding areas. Mountain Quail and mule deer would likely not benefit significantly in the first 50 years until the mid-successional stands began to open out and express a more productive shrub mid-story. The long list of old growth-associated species along with forest-roosting bats would benefit some from aging of the stands, but connectivity between older stands and minimum patch size of old growth stands would likely continue to limit expansion of these species in the first 50 years. California Spotted Owls would benefit in the largest contiguous patches of late-closed class.

Jeffrey Pine

All priority species were expected to be encountered in Jeffrey pine with the exception of California Spotted Owl, which exhibits a strong preference for closed mixed conifer and a lesser association with red fir but as fortune would have it, the only nesting pair currently known to inhabit the Nevada side of the Lake Tahoe Basin live in Jeffrey pine. Wildlife responses to modeled Jeffrey pine transitions would be similar to mixed conifer. A predominance of acreage in the mid-closed class would not yet provide full benefit to Mountain Quail and mule
deer and many other priority species would basically respond neutrally to the transition from early to mid-closed. The closing of older stands would improve conditions for Northern Goshawk, American marten, northern flying squirrel, shadow (Allen’s) chipmunk, and forest-roosting bats, but not necessarily for Flammulated Owl, White-headed Woodpecker, or Olive-sided Flycatcher, all preferential of open stands of large-DBH (diameter breast height) pine. The GBBO *Bird Responses To Climate Change Report* hypothesized the loss of individual White-headed Woodpecker pairs at the lowest elevations where Jeffrey pine might be lost in conversion to chaparral or pinyon-juniper, but the report stopped short of predicting an increase of White-headed Woodpeckers in the mid-closed class where most Nevada Bird Count detections occurred, citing large home range size and scale and resolution issues as confounding factors. In other words, White-headed Woodpeckers could be responding to forest stand conditions at a scale too fine for the analysis to pick up. Small occurrences of late-open stands within a classification polygon could be sufficient to maintain the species in a matrix of less-than-suitable habitat otherwise detectable by the remote sensing and bird survey techniques.

**Red Fir**

All priority species were expected to be encountered in red fir although Sooty Grouse, White-headed Woodpecker, and Lewis’s Woodpecker do not exhibit strong affinity for the type. The aging of red fir stands and improvement of ecological condition (decreased departure) was expected to benefit most all priority species that use the type. The priority species list did not appear to have a specific red-fir-facilitated species (at least in Nevada) on it such as Williamson’s Sapsucker or Pine Grosbeak, although Nevada’s northern flying squirrels might maximize their densities in the older age classes of red fir types.

**Lodgepole Pine**

All priority species were expected to be encountered in lodgepole pine although Mountain Quail, California Spotted Owl, White-headed Woodpecker, and shadow (Allen’s) chipmunk are not strongly associated with the types. Continued aging of the dry lodgepole pine community was (Allen’s) expected to benefit Sooty Grouse and forest-roosting bats, but the type’s value to other guilds of priority species was expected to be minimal without understory. Sooty Grouse prefer feeding on new needles of older trees over younger tree classes (Remington et al. 1996). Wet lodgepole pine transitioning from late-open to late-closed would be expected to benefit Northern Goshawk, Sooty Grouse, forest-roosting bats, American marten and northern flying squirrel. Priority species positively associated with open canopy and/or shrubby understory would not benefit from ageing and canopy closure – Flammulated Owl, Olive-sided Flycatcher, Sierra Nevada snowshoe hare, montane shrew, mule deer, Sierra alligator lizard.

**Subalpine Woodland**

Generally speaking, the subalpine woodland BpS in Nevada supports a less diverse community of priority wildlife species because those that respond positively to tall, large DBH trees are not well-served in whitebark pine which tends to grow multiple stems of smaller diameter from common root stocks, but there are some surprises, such as American marten which uses the type despite its preference for closed canopy and buildup of down woody material. Of birds, only the Cassin’s Finch and Olive-sided Flycatcher exhibit a strong affiliation with the type. In contrast, many more of priority mammals are expected to use the type – all except northern flying squirrel and shadow (Allen’s) chipmunk. The current predominance of open classes in this type and an inferred tendency to open even further with climate change would tend to favor Olive-sided Flycatcher, Sierra Nevada snowshoe hare, and mule deer, and decrease habitat value for American marten. Other priority species would probably exhibit neutral response to this trend. Forest-roosting bats would be expected to shift use from roosting to foraging. All species, however, will experience increasing loss of the BpS to red fir and Jeffrey pine.
Summary

The effects of climate change on Sierra coniferous forest types as a whole were not expected to target any particular priority species or group of species for significant change in distribution or survivability over the next 50 years. Current distributions and population sizes were not expected to change dramatically, although significant range shifts among BpS’s are predicted in the next 100 years. Other pressures associated with human use of the Sierra landscape are much more likely to impact occurrence and viability of Sierra coniferous habitats and the wildlife species that use them.

Taking Prescriptive Action

The Jeffrey pine and mixed conifer BpS’s were simulated for management in the Wildlife Action Plan climate change analysis. The management challenge in this habitat was the reduction of over-abundant young closed-canopied forests balanced against requirements to maintain older closed-canopied vegetation classes for special-needs species management. The projected invasion of cheatgrass into open forests with climate change was considered serious enough to warrant prescriptive grazing management. See Appendix C for further details on prescriptive actions.

Priority Research Needs

- More specific delineation of the use of Sierra coniferous forest successional stages and woodlands by priority species
- Effects of fire suppression, fragmentation, forest health, forest fuels reduction and salvage logging on species in Sierra coniferous forest and woodland habitats
- Winter range, migration corridors, and population viability of mule deer herds
- Range and population viability of American marten
- Range, status and population viability of Northern flying squirrels
- Population status and range of the Sierra Nevada snowshoe hare
- Population status of Aplodontia

Conservation Strategy

**Goal:** Thriving, self-sustaining wildlife populations in a dynamic landscape encompassing the full range of forest successional stages, with a local emphasis on the maintenance of old growth conifer forest conditions.

**Objective:** Set management direction and implement prescriptive strategies by 2022 to increase old growth (late-closed) mixed conifer 10% by 2062.

**Action:** Implement thinning and prescribed burning in mid-closed mixed conifer stands to open stand for faster DBH growth and promote the development of multi-aged conifer and woodland stands with complex structure (e.g., old growth conditions).

**Action:** Conserve the remaining Sierra coniferous forests and woodlands that have retained old growth or late-successional characteristics.
**Action:** Update Memorandum of Understanding (MOU) between the state of Nevada and the Humboldt-Toiyabe National Forest to provide continued protection of the last significant stands of old growth in the Carson Range.

**Action:** Identify and recommend Sierra Nevada old growth conifer forests and woodlands significant to wildlife for special management (i.e., Special Interest Areas or Special Management Areas) by the Humboldt-Toiyabe National Forest.

**Action:** Review and provide comments on the final proposed Special Interest Areas and Special Management Areas including old growth Sierra coniferous forests and woodlands in the Humboldt-Toiyabe National Forest revised management plan.

**Action:** Work with conservation partners in the Sierra Nevada ecoregion to achieve conservation objectives for Sierra coniferous forests and woodlands across its range in order to provide a landscape mosaic that includes forests retaining old growth and late successional characteristics.

**Objective:** Maintain late-open (old growth) Jeffrey pine at current relative percentages (13-14 % total Jeffrey pine acreage) through 2022, against predicted trends with climate change.

**Action:** Implement prescriptive grazing management to early and mid-successional stages vulnerable to annual grass invasion to reduce the percentage of annual grass-invaded Jeffrey pine acreage.

**Action:** Allow the natural aging of mid-successional classes to progress toward late-open through intensive sapling thinning and prescribed burning in mid-successional classes to release tree growth, shrub understory development, and promote uneven-aged, multi-storied stands tracking toward open old growth condition.

**Objective:** Manage lodgepole pine, red fir, and subalpine woodland communities not to exceed a 10% increase in ecological departure from current conditions through 2022.

**Action:** Review current management strategies for wet lodgepole pine, red fir, and subalpine woodland communities to determine if current strategy is sufficient to maintain current conditions through 50 years of climate change.

**Action:** Evaluate the need to apply prescriptive management to dry lodgepole pine in Nevada considering total acreage and relative significance to wildlife with particular emphasis on priority species needs and responses.

**Objective:** Maintain five active Northern Goshawk nesting territories in the Carson Range/Lake Tahoe Basin/Peavine Mountain region of Nevada through 2022.

“five active... territories” – based on three detections in the Tahoe Basin in 2005 with one prospective active territory each for Mount Rose and Peavine Mountain; “Active territory” confirmed by visual sighting or audible response to tape playback.
**Action:** Conduct standardized acoustic tape playback surveys in potentially suitable Northern Goshawk nesting habitat annually or at intervals not to exceed five years.

**Action:** Map suitable Northern Goshawk nesting habitat with “defended territory”, “nesting pair home range”, and “post-fledging dispersal” zones delineated based on active nest information as well as goshawk habitat suitability models.

**Action:** As necessary, assist the Humboldt-Toiyabe National Forest and Lake Tahoe Basin Management Unit (LTBMU) in the application and update of Northern Goshawk nest territory management standards and guidelines.

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**Objective:** Maintain a minimum of one active California Spotted Owl nest territory through 2022.

“One active… territory” – based on confirmation of nesting in Nevada in 2009.

**Action:** Conduct standardized surveys in potentially suitable California Spotted Owl nesting habitat annually or at intervals not to exceed five years.

**Action:** Map suitable California Spotted Owl nesting habitat with “defended territory,” “nesting pair home range,” and “post-fledging dispersal” zones delineated based on active nest information as well as spotted owl habitat suitability models.

**Action:** Adhere to Sierra Nevada Forest Plan Amendment management guidelines for spotted owl nesting zones.

**Action:** Conduct radio telemetry research on spotted owl fledglings to document juvenile dispersal, post-fledging habitat selection, and survival to document spotted owl behaviors and habitat use specific to Nevada habitat conditions.

**Action:** Document spotted owl prey selection specific to Nevada; assess prey population viability, relative abundance, and potential prey population management challenges.

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**Objective:** Maintain a minimum of one active Bald Eagle nest territory in the Nevada Carson Range/Lake Tahoe Basin/Peavine Mountain region through 2022.

“One active… territory” – based on known number of Bald Eagle nest territories in Nevada Sierra Nevada since mid-1990’s.

**Action:** Conduct annual status surveys in confirmed Bald Eagle territories; conduct comprehensive raptor nesting aerial surveys on Nevada side of Lake Tahoe Basin at intervals not to exceed five years.

**Action:** Limit disturbance and extraction activities within Bald Eagle nest buffer zones in compliance with National Bald Eagle Management Guidelines (FWS 2007).
Objective: Maintain Sooty Grouse and Mountain Quail populations at harvestable levels and current range and distribution through 2022.

“harvestable levels” – as determined through standardized annual evaluation of hunter questionnaires
“current range and distribution” – no loss of known occurrence sites as currently understood.

Action: Continue to document the delineation of range and distribution between Sooty Grouse and Dusky Grouse in Nevada.

Action: Maintain mixed conifer and lodgepole pine stands in late successional stages to facilitate Sooty Grouse feeding preferences for young needles off large mature conifer trees.

Action: Maintain a balanced mix of late-open (chaparral understory for feeding and brooding) and late-closed (roosting and wintering) successional stages in Sooty Grouse and Mountain Quail habitat.

Objective: Maintain 850 White-headed Woodpeckers in suitable habitat in the Nevada Sierra Nevada through 2022.

“850 White-headed Woodpeckers” – population estimate from the Nevada Bird Conservation Plan; measured via Nevada Bird Count surveys or other specialized survey as necessary.

Action: Apply management action, including prescriptions described above, to allow the natural transition from mid-successional stages to late-open class in Jeffrey Pine and mixed conifer.

Action: Conduct Nevada Bird Count transects in the Sierra Nevada. Investigate the need to augment survey network with additional transects as indicated by statistical power analysis.

Objective: Maintain Flammulated Owl populations at detectable levels in the Nevada Sierra Nevada through 2022.

“detectable levels” – as determined via nocturnal acoustic playback surveys conducted at intervals not to exceed five years.

Action: Conduct nocturnal acoustic playback surveys at regular intervals not to exceed five years.

Action: Apply management action, including prescriptions described above, to allow the natural transition from mid-successional stages to late-open class in Jeffrey Pine and mixed conifer.

Action: Encourage Nevada participation in west-wide Flammulated Owl Status and Trend Monitoring Project as endorsed and coordinated by the Partners In Flight Western Working Group.
Objective: Increase Olive-sided Flycatcher detections by 10% in mixed conifer and Jeffrey Pine by 2022.

“Increase... detections” as measured via Nevada Bird Count/Lake Tahoe Environmental Improvement Project surveys.

“10%” – The relative percentages of late successional classes of mixed conifer and Jeffrey pine are predicted to increase a combined total of 10% with climate change without management and a total of 19% with management.

**Action:** As opportunities exist, continue to apply prescribed forest management to mid-successional mixed conifer stands to open stand for faster DBH growth, open foraging zones, and promote the development of multi-aged conifer and woodland stands with complex structure.

**Action:** During forest thinning projects, promote the selection of the tallest snags for retention for Olive-sided Flycatcher hunting perches.

**Action:** Continue staffing of Nevada Bird Count/Tahoe EIP breeding bird surveys and conduct at regular intervals not to exceed five years.

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Objective: Maintain Lewis’s Woodpecker at detectable levels in suitable habitat through 2022.

“detectable levels” – as measured via Nevada Bird Count surveys or specific post-fire monitoring projects.

“suitable habitat” – in the Sierra Nevada, Lewis’s Woodpeckers are more responsive to post-fire conditions than in other regions of the state; therefore, Lewis’s Woodpecker occupancy and detectability in the Nevada Sierra Nevada is expected to be highest in recently burned areas before significant fall of snags and fire-killed trees occurs.

**Action:** Conduct post-fire wildlife surveys as regular protocol to measure wildlife response to catastrophic change as well as recovery.

**Action:** As standard protocol for fire wood salvage projects, leave at least 50% of standing dead trees intact for natural fall on a recent burn to facilitate the foraging and reproductive needs of Lewis’s Woodpecker and other fire-facilitated wildlife species.

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Objective: Maintain mule deer populations at current levels in the Nevada Sierra Nevada through 2022.

“current levels” – as determined by NDOW deer surveys

**Action:** Apply prescriptive management to mixed conifer and Jeffrey Pine stands designed to transition “closed” classes to “open” classes conducive to chaparral and mountain brush expansion.
Objective: Maintain forest-dwelling priority bat populations at detectable levels for all species in the Nevada Sierra Nevada through 2022.

“forest-dwelling priority bats” – hoary bat, silver-haired bat, spotted bat, long-eared myotis, little brown bat.
“detectable levels” – as measured by ANABAT acoustic surveys conducted at regular intervals not to exceed five years.

**Action:** Conduct surveillance ANABAT acoustic surveys in all five forest BpS’s at regular intervals not to exceed five years.

**Action:** Promote active and passive management strategies that encourage the natural transitioning of mid-successional classes to late-successional to promote better bat roosting conditions e.g. tall mature trees, closed canopies, cavities, exfoliating bark.

**Action:** Promote snag retention strategies in treatment/salvage/commercial harvest zones.

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Objective: Maintain priority terrestrial mammal populations at detectable levels for all species in the Nevada Sierra Nevada through 2022.

“priority terrestrial mammals” – Sierra Nevada snowshoe hare; montane shrew; American marten; northern flying squirrel; shadow (Allen’s) chipmunk; mountain pocket gopher.

“detectable levels” – as measured via live trap survey or remote camera array to be implemented at regular intervals not to exceed five years.

**Action:** Continue current radio telemetry monitoring research for northern flying squirrel and Sierra Nevada snowshoe hare with emphasis on relative abundance, range and distribution, and habitat preference.

**Action:** Initiate radio telemetry studies for American marten with emphasis on determining home range size, habitat preference, and suitable habitat connectivity analysis.

**Action:** Initiate a habitat preference study for shadow (Allen’s) chipmunk for the purpose of developing a functional suitable habitat model to predict distribution and relative abundance.

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Objective: Maintain Sierra Nevada alligator lizard at detectable levels in suitable habitats in the Nevada Sierra Nevada through 2022.

“suitable habitat” – as delineated through discovery surveys or a basic range and distribution investigative study.

**Action:** Initiate discovery surveys starting with areas of known occurrence and expanding into locations of similar habitat for the purpose of developing a cursory habitat preference model and preliminary sense of relative abundance.

**Action:** If deemed warranted as a result of initial investigations, develop a more detailed species assessment project with emphasis on completing a full range assessment, measured relative abundance, vetted suitable habitat model, and connectivity analysis.
Partnerships

Land Management/Ownership

<table>
<thead>
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<th>Land Owner/Manager</th>
<th>Percent</th>
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<td>U.S. Forest Service</td>
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<td>State of Nevada</td>
<td>9</td>
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<tr>
<td>Other</td>
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</table>

Existing partnerships, plans, and programs

Multi-partner
- Forest Stewardship Program

Federal & State Agencies
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Natural Resources Conservation Service/Conservation Districts
- Nevada Division of State Parks
- Nevada Department of Wildlife
- Nevada Division of Forestry
- Nevada Natural Heritage Program

Conservation Organizations
- Lahontan Audubon Society
- The Nature Conservancy
- Sierra Club

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

Other Key Partners
- Tahoe Regional Planning Agency
- Carson City; Washoe and Douglas Counties
- University of Nevada, Reno
- Great Basin Bird Observatory

Focal Area

Carson Range