APPENDIX A
SPECIES ASSESSMENTS AND CONSERVATION MEASURES

INTRODUCTION

This appendix provides brief conservation assessments for 18 native species occurring on national forests in the Sierra Nevada. The appendix also includes assessments and conservation measures for four introduced aquatic species that can adversely affect native aquatic ecosystems. The conservation measures noted here are intended for use in combination with the recommendations for forest plan revisions or other agency actions identified in the conservation strategy.

Table A-1. Species presented in Appendix A.

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Common Name</th>
<th>Page in Appendix A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>California golden trout</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Eagle Lake rainbow trout</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Goose Lake redband trout</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Hardhead</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Kern brook lamprey</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Lahontan cutthroat trout</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Mountain sucker</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Owens speckled dace.</td>
<td>17</td>
</tr>
<tr>
<td>Introduced aquatic</td>
<td>American bullfrog</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Bluegill</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>New Zealand mudsnail</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Quagga mussel</td>
<td>22</td>
</tr>
<tr>
<td>Amphibians</td>
<td>Mountain yellow-legged frog</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Yosemite toad</td>
<td>30</td>
</tr>
<tr>
<td>Mammals</td>
<td>Black bear</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Pacific fisher</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>American marten</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Wolverine</td>
<td>60</td>
</tr>
<tr>
<td>Birds</td>
<td>Black-backed woodpecker</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>California spotted owl</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>Great gray owl</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Northern goshawk</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Pileated woodpecker</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>Willow flycatcher</td>
<td>109</td>
</tr>
</tbody>
</table>

Our understanding about the life requirements and habitat needs for many special status species is expanding at a remarkable pace. Because of the research and monitoring being undertaken for key species, we recognize that the species accounts and conservation measures identified below are not static and will change over time. We encourage readers to visit the Sierra Forest Legacy website (www.sierraforestlegacy.org) for updates to these accounts. It is our intention to update the accounts periodically in an effort to capture the best available information to support conservation and management.

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We briefly note below species for which we expect additional information to be available in the next 12-18 months (Table A-2).

Table A-2 Species for which research or evaluation is ongoing and results anticipated in the coming 12-18 months.

<table>
<thead>
<tr>
<th>Species</th>
<th>Expected Research or Synthesis of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sierra Nevada yellow-legged frog</td>
<td>These species are expected to be proposed for federal listing in October 2012; recovery planning is expected to follow listing.</td>
</tr>
<tr>
<td><em>Rana sierrae</em> and <em>R. muscosa</em></td>
<td></td>
</tr>
<tr>
<td>Northern goshawk</td>
<td>A technical review of northern goshawk in California is expected to be issued by the US Fish and Wildlife Service in September 2012. Brian Woodbridge is the contact person for the review.</td>
</tr>
<tr>
<td><em>Accipiter gentilis</em></td>
<td></td>
</tr>
<tr>
<td>Pacific fisher</td>
<td>The Sierra Nevada Adaptive Management Project, Kings River Fisher Study, and regional monitoring are ongoing. Results from these studies are produced periodically and are expected at least through 2016. The Southern Sierra Nevada Fisher Working Group meets at least twice each year to address fisher concerns.</td>
</tr>
<tr>
<td><em>Martes pennanti</em></td>
<td></td>
</tr>
<tr>
<td>Pacific marten</td>
<td>Research is being undertaken by Katie Moriarty, Keith Slauson, and Bill Zielinski that focuses in the northern Sierra Nevada from Lake Tahoe to the Southern Cascades. Results from research on the Lassen National Forest are expected in late 2013.</td>
</tr>
<tr>
<td><em>Martes caurina</em></td>
<td></td>
</tr>
<tr>
<td>Yosemite toad</td>
<td>This species is expected to be proposed for federal listing in October 2012; recovery planning is expected to follow listing.</td>
</tr>
<tr>
<td><em>Bufo canorus</em></td>
<td></td>
</tr>
<tr>
<td>Forest Service Sensitive Species listed</td>
<td>The Sensitive Species lists are being revised by the Forest Service. Species are being removed and added as a result of this assessment. The new lists are expected to be available in October 2012.</td>
</tr>
</tbody>
</table>

Species accounts and conservation measures are under development for the species listed in Table A-3. These accounts should be available by mid-October, posted at the Sierra Forest Legacy website, and located within the electronic version of this conservation strategy.

Table A-3 Species for which conservation measures will be designed and presented in the electronic version of Appendix A posted on www.sierraforestlegacy.org by the end of October 2012.

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Reason for Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Empidonax traillii</em></td>
<td>Willow flycatcher</td>
<td>Species at risk</td>
</tr>
<tr>
<td><em>Centrocercus urophasianus</em></td>
<td>Greater sage grouse</td>
<td>Species at risk</td>
</tr>
<tr>
<td><em>Picoides arcticus</em></td>
<td>Black-backed woodpecker</td>
<td>Species at risk</td>
</tr>
</tbody>
</table>

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March 14, 2013
FISH

This section provides species accounts and conservation recommendations for the following fish (Table A-3).

Table A-3. Native fish species with species accounts and conservation recommendations (California Department of Fish and Game 2011, Moyle et al. 2011).

<table>
<thead>
<tr>
<th>Species</th>
<th>CDFG Status</th>
<th>Moyle et al. 2011 Status</th>
<th>Modoc</th>
<th>Lassen</th>
<th>Plumas</th>
<th>Tahoe</th>
<th>Eldorado</th>
<th>Stanislaus</th>
<th>Inyo</th>
<th>Sierra</th>
<th>Sequoia</th>
</tr>
</thead>
<tbody>
<tr>
<td>California golden trout</td>
<td>SC2</td>
<td>2-Vulnerable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><em>Oncorhynchus mykiss aguabonita</em></td>
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<tr>
<td>Eagle Lake rainbow trout</td>
<td>SC2</td>
<td>2-Vulnerable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>Oncorhynchus mykiss aquilarum</em></td>
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<td></td>
</tr>
<tr>
<td>Goose Lake redband trout</td>
<td>SC3</td>
<td>3-Watch List</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
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</tr>
<tr>
<td><em>Oncorhynchus mykiss subsp.</em></td>
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<td></td>
</tr>
<tr>
<td>Hardhead</td>
<td>SC3</td>
<td>3-Watch List</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td><em>Mylopharodon conocephalus</em></td>
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<td></td>
</tr>
<tr>
<td>Kern brook lamprey</td>
<td>SC2</td>
<td>2-Vulnerable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td><em>Lampetra hubbsi</em></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Kern River rainbow trout</td>
<td>SC1</td>
<td>1-Endangered</td>
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<td></td>
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<td></td>
<td></td>
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<td>x</td>
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<tr>
<td><em>Oncorhynchus mykiss gilberti</em></td>
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<td></td>
</tr>
<tr>
<td>Lahontan Lake tui chub</td>
<td>SC2</td>
<td>2-Vulnerable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
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<tr>
<td><em>Siphateles bicolor pectinifer</em></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mountain sucker</td>
<td>SC3</td>
<td>3-Watch List</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owens speckled dace</td>
<td>SC1</td>
<td>1-Endangered</td>
<td></td>
<td></td>
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<td></td>
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<td>x</td>
</tr>
<tr>
<td><em>Rinichthys osculus. subsp.</em></td>
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</tr>
</tbody>
</table>

California Golden Trout, *Oncorhynchus mykiss aguabonita* (Jordan)

**Issue Statement**

The California golden trout (*Oncorhynchus mykiss aguabonita*) is endemic to the Kern River drainages in and around the Sequoia National Forest. This small, brilliantly colored fish is the state fish of California and is much sought after by anglers. The California golden trout (CGT) was widely stocked outside of its native range over the last century for sport fishing, but simultaneously non-native trout were stocked throughout their native range resulting in serious predation and introgression issues. Introgression levels range from high (94 percent) in the lower watershed to low (8 percent) in the headwaters. It is estimated there are fewer than 2000 “pure” golden trout left, a decline of at least 95 percent from historical levels.

**Area Description**

The native range of the California golden trout is limited to the Kern River drainage at the southern end of the Sierra Nevada. Their historical distribution includes South Fork of the Kern River (which flows into Isabella
reservoir) and includes the Kern River tributaries Golden Trout Creek and Volcano Creek. By 1914, California golden trout collected from Golden Trout Creek were transported by pack train into numerous Sierran lakes and streams, extending their range by some 160 km. They have been continuously translocated to many waters within the Sierra Nevada and Rocky mountains. As a result, these fish are now found in more than 300 high mountain lakes and 1100 km of streams outside their native range though virtually all populations are introgressed with rainbow trout. A significant portion of CGT native habitat occurs on public lands managed by the Forest Service.


** Desired Condition **

CGT should be managed as a high priority species of special concern with an emphasis on retaining genetic integrity and improving and restoring habitat throughout their native range. Barriers to protect genetically pure CGT from rainbow/golden hybrids, rainbow trout, and competitor/predator species should be maintained.

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Objectives

- Maintain and enhance habitat throughout the range of CGT.
- Protect unhybridized populations from rainbow trout or introgressed golden/rainbow hybrids.
- Re-introduction of the species into appropriate areas from which it was extirpated.
- Maintain native aquatic foodwebs upon which CGT are dependent.
- Maintain protective barriers to prevent predatory or competitive species from invading CGT habitat.
- Research basic habitat and life history requirements for this species to aid in species conservation and restoration.

Conservation Measures

- Conduct a thorough research review of population genetics
- Implement habitat restoration where needed
- Connect populations where possible
- Eliminate non-native competing trout species

Eagle Lake Rainbow Trout, *Oncorhynchus mykiss aquilarum* (Snyder)

Issue Statement

The Eagle Lake rainbow trout (ELRT) is native to just a single watershed on the Lassen National Forest in northeastern California. Due to overfishing and habitat alteration from logging, railroads, livestock grazing, and water diversions, the ELRT has been essentially entirely hatchery propagated since 1959 when California Department of Fish and Game built an egg taking station on Pine Creek, the main tributary of Eagle Lake, as well as a weir to prevent ELRT from migrating into the river at spawning time. It is thought that a few ELRT would make it over the weir in wet years with the potential for successful spawning, though the numbers were so few and the habitat so degraded that these individuals could not represent a self-sustaining population. To further exacerbate habitat problems in Pine Creek, brook trout (*Salvelinus fontinalis*) were introduced into the upper watershed and are present in extremely high densities, competing with and predating upon ELRT. In 1995, the weir was improved to prevent migration into Pine Creek at any flow level. Considerable efforts have been made by state, local, and federal agencies, as well as stakeholders and resource groups to address the primary habitat problems in Pine Creek. There have been multiple releases of captive broodstock into the upper watershed since 2007 with documented successful spawning. Moyle et al. (2011) indicate that the ELRT is a species of high concern that is vulnerable to extinction in the next 50-100 years. It is essential that a percentage of the ELRT population be allowed to enter Pine Creek and attempt natural spawning on an annual basis.

Area Description

Eagle Lake is located near Susanville, California. It is a terminal alkaline lake that is highly productive and supports a unique fish fauna, though it is not uncommon for low oxygen events to cause fish kills in the winter. Pine Creek, Papoose Creek, and Merrill Creek are the three main tributaries, though Pine Creek is primary among them and likely supported the vast majority of the historical spawning. Pine Creek itself is quite small, only about 50 km long. The upper watershed is spring-fed and there is perennial water, however the lower watershed dries up approximately 6-9 months out of the year. The Eagle Lake watershed is a combination of conifer forested hills and wide, low gradient valleys that would historically have contained wet meadows, but many were drained to support livestock and railroad grades, which drastically changed their hydrology. It is possible that the water table drop from incised eroded stream channels and the abovementioned habitat...
alterations have created an even shorter season of flow in the lower watershed, further reducing ELRT’s ability use their native habitat.


Desired Condition

Eagle Lake Rainbow Trout should be restored as a self-sustaining population on Pine Creek. Continued habitat restoration and careful management of hatchery programs should enable this species to fully reoccupy its historical habitat.

Objectives

- Self-sustaining populations of Eagle Lake rainbow trout given access to Pine Creek
- Assess habitat restoration needs in the Eagle Lake watershed
- Reduce Brook Trout numbers in the upper watershed

Conservation Measures

- Allow spawning adults access to Pine Creek throughout the spawning season
- Further study actual ELRT use of Pine Creek over a variety of water years

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- Identify hydrologic requirements for ELRT spawning and rearing, i.e., minimum duration of instream water required for successful spawning, flow, temperature, and habitat use.
- Create a conservation plan for continued restoration and management efforts in the basin

**Goose Lake Redband Trout, Oncorhynchus mykiss ssp.**

**Issue Statement**

The Goose Lake redband trout (GLRT) is endemic to Goose Lake and its tributaries which is located on the Modoc National Forest. While it is genetically similar to many of the surrounding isolated populations of redband trout, there is little doubt that the isolation of Goose Lake (a terminal lake basin in all but the most extreme wet years) has created a distinct population segment that should be managed as such. There are two forms of Goose Lake redband, the lake form, which is grows to be much larger and is silvery in color, and the stream form, which mostly occurs higher in the watershed above barriers, remains small, and retains bright coloration and parr marks. Moyle et al. (2011) indicate the GLRT is a species of moderate concern for extinction in the next 100 years. Though mostly anecdotal, it appears that GLRT may have a higher thermal tolerance than other *Oncorhynchus* species. However, climate change impacts in this area may have a profound effect on both stream flows and temperature, making the GLRT vulnerable. Given the small geographic area inhabited, the isolated nature of populations, the occasional drying of Goose Lake, and the likely effects of climate change in the area, GLRT will require careful management and habitat restoration if they are to persist.

**Area Description**

Goose Lake spans the California/Oregon border in the northeast Corner of California. It is a highly productive alkaline terminal lake basin with only exceedingly rare connections to the Pit River drainage in extremely wet times. Goose Lake supports a highly distinct fish fauna. Willow and Lassen creeks are the primary streams that contain GLRT on the California side. Both have sustained extensive agricultural activities and have problems with stream channel erosion and incision, as well as other water quality issues, though land owners have made considerable efforts in recent years to avoid Endangered Species Act designation. Willow and Lassen creeks both vary between low gradient meadow habitat and steep rocky gorges that are barriers to upstream fish passage. Cold Creek, a tributary of Lassen Creek, is the most likely spawning site for lake form GLRT in California. There have been numerous attempts at meadow restorations in Willow and Lassen creeks with varying results.
Figure A-3. Distribution of Goose Lake redband according to Trout Unlimited’s Conservation Success Index. This map includes Warner Mountains populations as well. [http://tucsi.tu.org/CSIMaps.aspx?SpKey=27](http://tucsi.tu.org/CSIMaps.aspx?SpKey=27), accessed 11/26/11
Desired Condition

Maintain, protect, and enhance populations of Goose Lake redband throughout their range. Key habitats should be identified and protected, particularly in light of potential climate change effects.

Objectives

- Maintain self-sustaining populations GLRT
- Assess habitat restoration needs in the Goose Lake watershed
- Maintain native fish assemblage in Goose Lake watershed

Conservation Measures

- Maintain free access of GLRT to their spawning streams
- Monitor all GLRT populations
- Identify key limiting factors
- Identify implement key habitat restoration projects in Goose Lake watershed
- Assist land owners in implementing best management practices
- Manage non-native species to limit adverse impacts on GLRT

Hardhead, *Mylopharodon conocephalus* (Baird and Girard)

Issue Statement

Hardhead are a large cyprinid (minnow family) native to the waters of the Central Valley and its foothill tributaries. They are considered a species of moderate concern by Moyle et al. (2011). Though there is relatively little information available on their status, trends, and present distribution, most populations are likely small, isolated, and declining in numbers. The hardhead is widely, but patchily distributed in foothill rivers and tributaries and can thrive in reservoirs provided that water levels do not fluctuate widely and they are not highly invaded by non-native predators such as bass and bluegill. There have been notable population crashes of numerous reservoir populations of hardhead throughout their range in recent years. Hardhead are poor swimmers, rendering them frequently incapable of swimming over fish ladders designed for salmonids and unable to reoccupy streams and tributaries they have been extirpated from. While not in immediate jeopardy of extinction, hardhead occupy a unique niche in California’s aquatic ecosystems and are not well studied or monitored at the present.

Area Description

Hardhead occupy large and small riverine habitats from the mainstem Sacramento and San Joaquin rivers to an elevation of approximately 1500 meters. They are widely distributed and locally abundant in the foothill tributaries where they tend to inhabit deep pool and run habitats with low velocities. While their occupied habitats are widely altered by large, mid-elevation reservoirs that isolate populations, hardhead are able to use these habitats provided they are not heavily invaded by non-native predatory fishes such as bass. Interestingly, hardhead are absent from the Cosumnes River, one of the few undammed rivers of any size remaining in the foothills, presumably because of the presence of invasive redeye bass (*Micropterus coosae*).
**Desired Condition**

Existing hardhead populations should be conserved throughout their range. All known populations are in need of ongoing monitoring to ensure their continued existence in the face of climate change and continued anthropogenic activities throughout their range as well as the recent crashes of numerous reservoir populations.

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Non-native fishes are a continuous threat to the hardhead, particularly aggressive warm water species such as bass, bluegill, and sunfish. Removal of non-native species from key habitats may be necessary to protect the species. Hardhead should be reintroduced to historically occupied areas from which they have been extirpated.

**Objectives**

- Protect existing populations of hardhead.
- Determine the current actual distribution of hardhead.
- Reconnect extant populations.
- Protect extant populations from non-native species.
- Reintroduce hardhead to formerly occupied areas.

**Conservation Measures**

- Establish a monitoring program for all populations of hardhead.
- Determine habitat needs and limiting factors for hardhead.
- Complete formal taxonomic and genetic studies on taxonomic status and publish results in a peer-reviewed journal.
- Use basic habitat and life history requirements for this species to aid in species conservation and restoration.

**Kern Brook Lamprey, Lampetra hubbsi (Vladykov and Kott)**

**Issue Statement**

The Kern brook lamprey (KBL) was first described as a species in 1976. It is a small, non-predatory lamprey endemic to the San Joaquin and Kings rivers. Relatively little is known about its ecology and life history. It appears that its historic range has largely been bisected and isolated by dams and diversions. The effect of large dams, water diversions, channel alteration, and agricultural and urban runoff are presumably profound on this poorly studied species. The habitat requirements of the KBL appear to include backwater habitats where ammocetes (larval lamprey) emerge from the mud to filter food from the water column. Adults require coarser gravel for spawning. They seem to prefer cooler water, rarely exceeding 25°C indicating that they may historically have been distributed higher in the watersheds. While little is known about this endemic lamprey, all efforts should be made by land managers to conserve existing populations, reconnect populations, and learn the life history requirements of this species to promote better conservation. It is listed as a species of high concern by Moyle et al. (2011) and it is their recommendation that it be treated as a threatened species until more information becomes available on its true status.

**Area Description**

The Kern brook lamprey is found in the major drainages of the San Joaquin and Kings rivers including the Merced and Kaweah rivers. Most extent populations of KBL are found below the major dams on the Merced, Kaweah, Kings, and San Joaquin rivers, however they have also been found in the Kings River above Pine Flat Reservoir and the San Joaquin River above Millerton Reservoir. The average elevation where KBL are found is 135 meters. Their current patchy distribution throughout the middle San Joaquin system indicates that the population is likely greatly reduced from its historic numbers. The extensive agricultural and urban activities in the region are the most probable influences, though the KBL are so poorly understood that it is hard to determine. Interestingly, the ammocetes appear to thrive in the dark siphons of the Friant-Kern Canal, though
due to the lack of appropriate spawning habitat, it seems unlikely that those individuals are successfully contributing to the population.

Figure A-5. Kern brook lamprey distribution in and adjacent to Sierra and Sequoia National Forests from http://ice.ucdavis.edu/aquadiv/fishcovs/fishmaps.html accessed 11/26/11
Desired Condition

The Kern brook lamprey presents a unique conservation opportunity since it is so recently described and so little is known about its historic distribution, ecology, and life history. Determining its habitat requirements is critical to creating a conservation and management plan for the species. Reconnecting extant populations and maintaining habitats that support KBL are essential to their conservation.

Objectives

- Determine the life history requirements of the species.
- Determine the true distribution of KBL.
- Provide KBL refuges, particularly in areas where dams, diversions, agricultural return waters, and channel alteration are highest.
- Reconnect extant populations.
- Identify limiting factors to the species and reduce adverse impacts.
- Explore the possibility of reintroductions of KBL in their native range.

Conservation Measures

- Establish a monitoring program for all populations of Kern brook lamprey and prevent further loss of any known populations.
- Complete formal taxonomic and genetic studies on taxonomic status and publish results in a peer-reviewed journal.
- Use basic habitat and life history requirements for this species to aid in species conservation and restoration.

Lahontan Cutthroat Trout, *Oncorhynchus clarki henshawi*

Issue Statement

Lahontan cutthroat trout (LCT) are a cutthroat trout subspecies native to the interior western United States. In 1970, Lahontan cutthroat trout were listed as federally endangered, but were reclassified as threatened in 1975 to facilitate management and allow angling. In a more recent status assessment, Moyle et al. (2008) indicated that the species is vulnerable to extinction in the next 100 years (score of 2). Both a stream form and lake form of LCT exist in California. The lake form has largely been displaced by overharvest and competition from introduced trout species such as mackinaw (*Salvelinus namaycush*) and brown trout (*Salmo trutta*). The stream form has suffered primarily from habitat alteration and predation and competition from non-native species. Lahontan cutthroat readily hybridize with the ubiquitously stocked rainbow trout (*Oncorhynchus mykiss*), which has been a major issue for their conservation and management throughout their range. Additionally, channel alteration, diversions, logging activities, and livestock grazing have all had profound effects on LCT habitat.

Area Description

Lahontan cutthroat trout are patchily distributed across the Lahontan system within eastern California and includes the Truckee River, Lake Tahoe Basin, Honey Lake, Eagle Lake, Walker River, and the Carson-Humboldt. They inhabit waters ranging from tiny alpine creeks to large, low gradient rivers in the Great Basin. The lake form lived in both alkaline terminal lakes such as Walker and Pyramid Lake as well as more oligotrophic alpine lakes such as Lake Tahoe and Independence Lake. Currently, LCT exist in about 11 percent March 14, 2013
of their historic riverine habitat and approximately 0.4 percent of their historic lacustrine habitat. A significant portion of LCT habitat occurs on public lands managed by the U.S. Bureau of Reclamation and U.S. Forest Service.

Figure A-6. Historic and current distribution of Lahontan cutthroat trout from the Trout Unlimited Conservation Success Index (CSI) accessed at: http://www.tu.org/science/conservation-success-index

**Desired Condition**

Lahontan cutthroat trout populations in California should be managed for adequate habitat condition and genetic integrity throughout their existing range and reintroduced into formerly occupied areas wherever possible.

**Objectives**

- Protect existing populations of LCT
- Reconnect extant populations
- Protect extant populations from non-native species
- Reintroduce LCT to formerly occupied areas
- Restore self-sustaining wild populations of both stream and lake type LCT
- Determine likely effects of climate change to LCT populations

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Conservation Measures

- Continue monitoring program for all populations of LCT
- Maintain genetic integrity of broodstock and wild populations
- Eradicate non-native competitors and predators from LCT occupied streams
- Monitor and protect LCT habitat from anthropogenic impacts
- Identify key areas for restoration and reintroduction based on potential LCT carrying capacity and habitat value

Mountain Sucker, *Catostomus platyrhynchus* (Cope)

Issue Statement

The mountain sucker is a stream adapted sucker that is originally native only to the Lahontan drainage in California, but was introduced into a tributary of the north fork of the Feather River, presumably through irrigation ditches. Mountain suckers prefer the lower reaches of perennial streams and are in decline throughout their range in California, largely as a result of their inability to persist in reservoirs. The Lahontan basin (including the Feather River population) is likely a distinct taxon due to long geographic separation from other populations, though this has not been examined closely. The mountain sucker is listed as a species of moderate concern by Moyle et al. (2011), though surveys indicate their numbers and distributions are in decline and most populations are isolated from one another. The abundant translocated population in Red Clover Creek in Plumas National Forest represents an opportunity to conserve a species that is in decline in its native range in a nearby system.

Area Description

Mountain suckers inhabit many of the Lahontan drainages in the eastern Sierra, including Honey Lake area, the Susan River, and the Truckee, Carson and Walker rivers. The preferred habitat of mountain suckers is shallow, perennial streams, particularly the lower reaches which are frequently inundated by reservoirs. Low gradient meadow streams are particularly well liked by mountain suckers, which are fairly tolerant of water quality. At Red Clover Creek (site of a translocated population in the Plumas National Forest) a broad meadow system is bisected by a historically highly degraded stream channel that has been the site of large scale meadow restoration efforts by the Plumas Corp. This makes it an especially important system to monitor due to the locally abundant population of mountain suckers and the large-scale habitat changes under way at Red Clover Creek.

Desired Condition

Mountain suckers should be conserved in occupied streams with ongoing population monitoring, especially in streams where they were historically abundant and have suffered recent population declines (i.e. Sagehen Creek since the construction of Stampede Reservoir). Also of interest is the taxonomic status of the Lahontan populations vs. Rocky Mountains and beyond.

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Objectives

- Protect existing populations of Mountain sucker throughout their native habitat.
- Study and monitor the translocated population at Red Clover Creek as an example of how mountain suckers respond to meadow restoration activities.
- Identify and protect key mountain sucker habitat.
- Examine the potential for introgression with Tahoe sucker in concurrent ranges.

Conservation Measures

- Establish an ongoing monitoring program for all populations of mountain sucker.
- Identify areas of introgression with Tahoe sucker.
- Identify current distribution and population trends, particularly in light of climate change.

Owens speckled dace, Rhinichthys osculus ssp.

Issue Statement

The Owens speckled dace (OSD) is a speckled dace subspecies native to the Owens River drainages in the eastern Sierra Nevada of California. Its current distribution is limited to a handful of isolated populations in the East Fork of the Owens River near Benton and a number of irrigation ditches in the Bishop area. The most complete recent survey of aquatic habitats in the Owens Valley indicates that OSD have been extirpated from the vast majority of their range and are currently only found in approximately nine locations. While not formally listed under either state or federal endangered species laws, the OSD is certainly highly susceptible to extinction in the next 50-100 years based primarily on habitat alteration, water diversions, recreational use of the springs they inhabit, and introduction of a number of non-native species that either predate upon or compete with speckled dace.

Area Description

Speckled dace are considered the most widely distributed fish species in the western United States. However, most populations are effectively isolated from each other which results in significant morphological and genetic differences between populations. The OSD are most closely related to the Amargosa River speckled dace in Death Valley which would have had occasional connection to the Owens Valley through Pleistocene Lake Manley. The OSD inhabit small streams and hot spring complexes feeding on tiny insects and algae. They are generally found in water temperatures less than 29°C. The Owens Valley runs roughly north/south between the east side of the Sierra Nevada and the west side of the White Mountains. It is a snowmelt fed system with many geothermal and cold water spring systems as well. Historic surveys of the Owens Valley indicated that OSD occupied nearly all small springs and creeks in the Owens Valley. Current distribution is limited to just nine sites in the Owens Basin representing 7 separate populations. The population in Long Valley at Whitmore Hot Springs in now recognized as a separate taxon. There are five populations in the northern Owens Valley at North McNally Ditch, North Fork Bishop Creek, an irrigation ditch in north Bishop, Lower Horton Creek, and Lower Pine and Rock creeks, and a single small population remaining in the East Fork Owens River drainage at Lower Marble Creek near Benton.

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Figure A-8. Owens speckled dace distribution in the Owens River Valley from the 1995 Department of Fish and Game publication “Fish Species of Special Concern in California, Second Edition,” by P. B. Moyle, R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. Accessed 11/26/11
**Desired Condition**

Owens speckled dace should be managed as a species of special concern with an emphasis on protecting remaining populations and their habitat, as well as preventing further population losses due to diversions, non-native species introductions, and recreational use of warm springs. The current abundance and distribution of OSD indicates that protection under the Endangered Species Act is warranted.

**Objectives**

The most critical needs for Owens speckled dace according to Moyle et al. (2011) include:

- Provide formal protection of existing habitat, including creating special refuges in irrigated agricultural areas.
- Eliminate non-native fishes from springs historically occupied by speckled dace and reintroduce dace from local brood stock.
- Establish Owens speckled dace at additional sites in the Benton and Northern Owens Valley region.

**Conservation Measures**

- Establish an annual monitoring program for all populations directed towards early detection and mitigation of habitat changes and to the establishment of non-native fishes.
- Complete formal taxonomic and genetic studies to determine taxonomic status.
- Research basic habitat and life history requirements for this species to aid in species conservation and restoration.

**References**


INTRODUCED AQUATIC SPECIES

The following introduced aquatic species are included here because of the adverse impacts they have had on aquatic systems and native fish and amphibians.

American Bullfrog, *Lithobates catesbeianus*

**Issue Statement**

The American bullfrog, *Lithobates catesbeianus*, native to the eastern United States, has become a widespread global invader. As the largest frog found in the U.S., they are exceptionally adaptable and negatively impact native ecosystems through competition, predation, and introduction of disease. They were first introduced into California in 1898 to satisfy the market for frog’s legs, were common in the pet trade, and have become naturalized throughout much of the available aquatic habitat in California to the detriment of native frogs, birds, fishes, and other species.

Species ecology
- They are voracious predators.
- Bullfrogs have been found to be carriers for the fungal disease *Chytridiomycosis*, which is responsible for devastating amphibian populations globally, though they appear to have little susceptibility to the disease themselves.
- Bullfrogs are highly fecund.
- Bullfrogs can migrate large distances.

Habitat preferences
- Warm, permanent bodies of water including lakes and streams, agricultural ponds.
- Bullfrogs are generally found below 5,000 feet elevation in California, though their range may expand with climate change.
- Tadpoles require anywhere from 3 months to over a year to transform, depending on temperature.

Methods of spread
- Pet trade
- Food trade (widely available in Asian markets)
- Bait buckets

Means of control
- Removal of adults
- Draining ponds to kill tadpoles

**Control Measures**

- Remove bullfrogs from habitats where they negatively affect species of concern.
- Control existing populations and prevent further spread.
- Monitor existing populations and vulnerable habitats regularly.
- Take measures to eradicate bullfrogs where feasible.

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Bluegill, *Lepomis macrochirus*

**Issue Statement**

Bluegill are native to the eastern United States. They have been introduced as sport fish in many bodies of water where they compete with native fishes for habitat and food. They become prolific and are highly aggressive in establishing and defending territories. They were introduced to Lake Tahoe in the 1970s, presumably by anglers, and along with Largemouth bass, threaten what remains of native fisheries. The concurrent introduction and spread of the aquatic invasive weed, Eurasian watermilfoil, has likely facilitated the success of bluegill in Lake Tahoe by providing cover. Typically, bluegill prefer water 60-80°F, but populations continue to grow in Tahoe and its tributaries indicating both ecological plasticity and a potential range expansion associated with climate change.

**Species ecology**
- Bluegill are a member of the family Centrarchidae, the sunfishes, which typically prefer warm waters
- Generalist carnivores on mollusks and small fishes
- Aggressively defends territories and nests

**Habitat preferences**
- Slow to moderate flow
- Warm waters
- Prefers lots of cover, i.e., downed wood, aquatic macrophytes, undercut banks

**Method of spread**
- Anglers

**Means of control**
- Electrofishing
- Remove fishing bag limits to encourage anglers
- Chemical treatments (undesirable option due to killing non-target species)

**Control Measures**

- Control and reduce existing Bluegill populations.
- Prevent of further spread.
- Prohibit intentional stocking of Bluegill in sensitive habitats or areas where they can escape into the wild.

New Zealand Mudsnail, *Potamopyrgus antipodarum*

**Issue Statement**

The New Zealand mudsnail was first documented in North America on the Snake River in Idaho in 1987. Since that time is has spread throughout the western United States and the Great Lakes region. In California, it is widespread through the Central Valley rivers and their tributaries, the eastern Sierra Nevada. The snails tolerate heavy siltation (e.g., Colorado River) as well as cold, clear alpine streams (e.g., the eastern Sierra). The snail thrives in eutrophic and disturbed systems with heavy algae growth and competes with native invertebrates for...
food. New Zealand mudsnails can reach densities of 300,000 individuals per square meter under favorable conditions, which can profoundly alter nutrient cycling and primary production in a system. This puts them at a competitive advantage and can reduce the availability of food for native invertebrates and fishes. Further, they can pass through the gut of a fish alive and intact, which means they are a) not nutritionally usable as fish food, and b) able to migrate using fish as a vector. Their sheer densities make them likely ecosystem engineers.

Species ecology
- 95 percent of New Zealand mudsnails are parthenogenic females
- All populations of mudsnails in the United States are clonal females
- The can tolerate a wide range of temperatures and salinities
- New Zealand mudsnails are grazers on algae, diatoms, and other plant material

Habitat preferences
- Any water less than 50m deep is susceptible to mudsnail invasions

Method of spread
- Boat bottoms
- Ballast water
- Fishing equipment
- Waders

Means of control
- Prevent new introductions.
- Potential for biocontrol with trematodes, but not currently used.
- In hatchery situations, CO₂ treatments have proven effective at removing mudsnails.
- Actively clean all fishing gear, boats, bilge water, live wells, and other equipment that may harbor mudsnails.
- Educate the public to recognize NZ mudsnails and take appropriate measures to control spread.

Control Measures
- No new introductions of NZ mudsnails in the Sierra Nevada.
- Control and reduce existing populations.
- Educate the public to recognize NZ mudsnails and take appropriate measures to control spread.

Quagga Mussels, *Dreissena rostriformis bugensis*

Issue Statement

Quagga mussels, a close relative of the zebra mussel, *D. polymorpha*, were first brought to the U.S. in ballast water from shipping vessels traveling from Europe to the Great Lakes. It followed on the heels of the zebra mussel invasion and has very similar ecology and life history attributes. The quagga mussel causes profound changes to the habitats it invades as well as causing serious economic impacts. Quagga mussels are currently found in numerous southern California reservoirs as well as reservoirs on the Colorado River, and in Nevada. With known populations so close to the Sierra Nevada the potential for future introductions is high.
Species ecology
Quagga and zebra mussels are exceptional water filterers, and they impact ecosystems by filtering out significant amounts of plankton and fine particles from the water. This negatively affects zooplankton, which feed on plankton, as well as larval fishes and other species that use both plankton and zooplankton for food. A secondary impact from quagga mussels is the waste they eliminate, called pseudofeces, which settles around the colony, fouling the bottom, causing a drop in pH, and producing toxic byproducts. Additionally, quagga mussels colonize both hard and soft substrates very quickly which can cause severe economic problems with shipping, water intake and outlet pipes, waste water treatment plants, as well as impacting beaches, boats, and docks.

Habitat preferences
- Opportunistic on both hard and soft substrates.
- Prefers cold water.
- Can be found at the surface or depths of up to 130m.

Method of spread
- Most easily spread at larval stage in ballast or bilge water on ships and recreational vessels.
- Capable of spreading through canals and locks.

Means of control
- Prevent spread.
- Chemical treatments have had limited application due to fears of killing non-target aquatic species.
- Oxygen deprivation, exposure and desiccation, radiation, manual scraping, high-pressure jetting (including with high temperature water), mechanical filtration to kill individuals.
- Molluscicides, ozone, antifouling coatings, electric currents, and sonic vibration can be used to control mussels, but have detrimental collateral impacts that may not be sustainable.
- Current research on biocontrol with a bacterium, *Pseudomonas fluorescens*.

Control Measures
- Prevent further spread of quagga mussels.
- Contain and reduce existing populations.
- Educate the public about the problem and continue boat checkpoints to prevent introduction into key habitats such as Lake Tahoe.
- Develop effective control methods.

References


AMPHIBIANS

This section provides species accounts and conservation recommendations for the following amphibians (Table A-4).

Table A-4. Native amphibians with species accounts and conservation recommendations in this section (USDA Forest Service 2001, USDA Forest Service 2007).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Status</th>
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<td><em>Rana sierrae</em> and <em>R. muscosa</em></td>
<td>Mountain yellow-legged frog complex</td>
<td>FWBP, FSS, CSSC</td>
</tr>
<tr>
<td><em>Bufo canorus</em></td>
<td>Yosemite toad</td>
<td>FC, FSS, CSSC</td>
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Mountain Yellow-Legged Frog Complex (*Rana sierrae* and *R. muscosa*)

Issue Statement

The mountain yellow-legged frog is a species complex made up of two species (Vredenburg et al. 2007), the Sierra Nevada mountain yellow-legged frog (*Rana sierrae*) and the southern mountain yellow-legged frog (*Rana muscosa*). Historically, the mountain yellow-legged frog was described as extremely abundant (Grinnell and Storer 1924; Mullally and Cunningham 1956). Today both species are critically at risk of extinction. Comparing historical versus current occupancy for all verified localities, based on museum specimens, Vredenburg et al. (2007) determined that *Rana sierrae* and *Rana muscosa* are now absent from more than 92 percent of historic localities in the Sierra Nevada. Using additional historical records of occupied localities, the U.S. Fish and Wildlife Service concluded in 2011 that 76 percent of historical populations of mountain yellow-legged frog have been extirpated, 54 percent of populations that were extant in 1995 are currently extirpated, and remaining populations have undergone a 19 percent decline in abundance since 1995 (USFWS 2011).

The primary threats to the survival of this amphibian are predation by non-native trout on mountain yellow-legged tadpoles and adults, and infection by the chytrid fungus (*Batrachochytrium dendrobatidi*) that is causing amphibian declines world wide at this time. Other sources of threats which can further reduce viability include wildland fires, fire suppression activities, airborne contaminants including toxins from pesticides and herbicides, climate change, livestock impacts, water developments, and off-highway vehicle (OHV) and other types of recreation (US FWS 2011).

Distribution and Ecology

*Rana sierrae* is endemic to the Sierra Nevada of California and adjacent Nevada. In the north, its range extends from the Feather River in Butte and Plumas Counties, south to the Monarch Divide and Cirque Crest (Fresno County), and to Independence Creek in Inyo County east of the Sierra Nevada crest. Populations in Nevada consist only on the east and north-east sides of Lake Tahoe in the Carson Range and vicinity. Within the Sierra Nevada, the range of *R. muscosa* extends from the Monarch Divide and Cirque Crest to Taylor and Dunlap Meadows in Tulare County. An isolated population also occurred on Breckenridge Mountain (Kern County). Today, most populations of mountain yellow-legged frog are in Sequoia, Kings Canyon, and Yosemite National Parks (Knapp and Matthews 2000a). In southern California, *R. muscosa* is now restricted to fewer than 10 sites in the San Gabriel and San Jacinto Mountains that collectively harbor fewer than 100 adult frogs (Jennings and
Hayes 1994). In this conservation strategy, we will limit our discussion to those frogs found within the Sierra Nevada.\(^2\)

In the Sierra Nevada the elevation range occupied by both species was between 1400 meters and 3690 meters. The species is usually associated with montane riparian habitats in lodgepole pine, yellow pine, sugar pine, white fir, whitebark pine, and wet meadow vegetation types. Habitat of the mountain yellow-legged frog consists of glaciated lakes, ponds, tarns, springs, and streams in the Sierra Nevada. The adaptations that allow them to live at these high elevations and cold temperatures have made them highly vulnerable to introduced fish species.

Mountain yellow-legged frogs are moderately sized ranids ranging between 45-90 mm from snout to vent. All stages of the mountain yellow-legged frog are aquatic. Tadpoles range in size up to 90 mm total length. Frogs spend 8-9 months overwintering under ice. The adults emerge soon after snowmelt in the spring, and breed soon after. Adults lay a single egg mass of 10 to 100 eggs, which hatch in approximately 16-21 days (Vrendenberg 2005 in FWS 2011). Tadpoles typically require 2-3 years (1-4) to metamorphose into juvenile frogs. Juvenile frogs require 3-4 years to reach sexual maturity.

**Threats**

Until the mid-1800s, fish were absent from nearly all high elevation habitats in California (Moyle et al. 1996, Knapp 1996, Moyle 2002). Stocking trout into high elevation lakes became a common practice during the early 1900s (Knapp 1996) and targeted larger, perennial lakes and streams. According to US FWS data, 87 percent of historically fishless lakes that are 10 acres or larger in surface area and 10 feet or deeper currently have introduced trout populations (USFWS 2011). There are abundant scientific studies indicating that predation by non-native trout has decimated the populations of mountain yellow-legged frogs in formerly fish-less mountain lakes and streams (Bradford 1989, Bradford et al. 1993, Bradford et al. 1998, Knapp and Matthews 2000a,b; Knapp et al. 2003, Vredenburg 2004, Knapp et al. 2007).

Recent surveys also have shown an increase in the deadly disease chytridiomycosis, caused by the fungus *Batrachochytrium dendrobatidis* (*Bd*), that is decimating amphibian populations worldwide. It is thought to have originated in Africa and Asia, and was first described in 1999. Retroactive examination of museum specimens has demonstrated that *Bd* first appeared in California during the early 1960s. It is now widespread across the state (Padgett-Flohr and Hopkins 2009). Mountain yellow-legged frogs are highly susceptible to the disease and it is now common in populations of mountain yellow-legged frog throughout the Sierra Nevada (Fellers et al. 2001, Knapp and Morgan 2006, Rachowicz et al. 2006). Chytridiomycosis typically causes massive die-offs of adult and juvenile frogs, leading to population extinctions (Rachowicz et al. 2006; Vredenburg et al. 2010). However, despite ongoing *B. dendrobatidis* infections, some mountain yellow-legged frog populations have continued to persist. This is the only real source of hope for the continued existence of this amphibian (Briggs et al. 2005, Briggs et al. 2010). If predatory fish are also removed from their habitats, the amphibian may be able to recover. Nearly all the remaining populations of mountain yellow-legged frog occur on public lands, and studies have demonstrated that in the absence of disease, it is possible to bring these species back to recovery (Knapp et al 2007).

\(^2\) In southern California, *R. muscosa* was known from the Transverse and Peninsular Ranges, including the San Gabriel Mountains (Los Angeles and San Bernardino Counties), San Bernardino Mountains (San Bernardino County), and San Jacinto Mountains (Riverside County). A disjunct population also existed on Mt. Palomar (San Diego County).

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The Sierra Nevada Framework Plan provided strategies to reduce all the factors causing a decline in mountain yellow-legged frog populations including the removal of exotic fish from frog habitat, prohibition of pesticides from frog habitat, removing livestock near lakes and pond areas, prohibiting development of new recreation trails that would affect known frog sites, and the identification of Critical Aquatic Refuges to protect sensitive species. The 2004 revisions to the Framework weakened the protections for the mountain yellow-legged frog by failing to maintain grazing restrictions for amphibian species in key habitats. A return to a robust monitoring and restoration program as promoted and required by the original Sierra Nevada Framework is vital to protect the species from disappearing from the Sierra Nevada altogether.

In 2003 the U.S. Fish and Wildlife Service (USFWS) determined that the Sierra Nevada population of the mountain yellow-legged frog should be protected under the Endangered Species Act, but that listing the species under the Act is "warranted but precluded" by the agency's backlog of priorities and budget constraints. On September 15, 2010, the California Fish and Game Commission accepted a petition from the Center for Biological Diversity to list all populations of the mountain yellow-legged frog (*Rana muscosa* and *Rana sierrae*) as "endangered" under the California Endangered Species Act. As a result, both species were listed as "candidate" species and will be managed as "endangered" until the U.S. Fish and Wildlife Service releases its proposed rule related to listing under the U.S. Endangered Species Act in October 2012.

**Desired Condition**

Sierra yellow-legged frogs are well distributed and occupy their historic range in numbers that reflect a stable and increasing population. Essential habitat is well represented across the species’ range as follows: in lentic habitats, or glaciated regions with still water, watersheds or sub-watersheds are trout-free and contain a mix of large (more than 1 ha), deep (more than 1 m) lakes, shallow ponds, and wet meadows interconnected with perennial streams. Where lotic habitats predominate, trout-free watersheds (or sub-watersheds) occur with an extensive network of low and moderate gradient perennial stream reaches containing deep pools and other key habitat elements necessary for all life stages (US FWS 2011). Re-introduced populations are resistant to chytridiomycosis and are stable. Populations are managed to maximize resiliency to human-caused and natural stressors.

**Objectives**

- Maintain and enhance essential habitat throughout the range of mountain yellow-legged frog.
- Identify and reduce stressors, both natural and human-caused, in order to maximize resilience in populations
- Re-introduction of the species into appropriate areas from which it was extirpated.
- Maintain native aquatic foodwebs upon which mountain yellow-legged frog are dependent.

**Conservation Measures**

- Coordinate with the California Department of Fish and Game and the U.S. Fish and Wildlife Service to implement recovery plan for the species
- Restore fishless habitat for mountain yellow-legged frog
- Implement habitat restoration measures where needed
- Create clusters of interconnected fishless lakes and ponds providing high quality habitat for mountain yellow-legged frogs and that could be naturally recolonized from nearby source populations.
- Eliminate the stocking of lakes harboring self-sustaining trout populations

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• Eliminate populations of non-native predatory species
• Re-introduce mountain yellow-legged frog to appropriate areas
• Reduce recreation pressure in known occupied sites
• Prohibit pesticide use in frog habitat

References


Yosemite Toad (*Bufo canorus*)

**Issue Statement**

The Yosemite toad is declining in both population and range throughout the Sierra Nevada, disappearing from over 50 percent of its historic range. In addition, remaining populations appear to be in decline (Sherman and Morton 1993, Drost and Fellers 1996, Davidson et al. 2002).

Declines, some in seemingly pristine environments, occurred in the eastern Sierra Nevada between the early 1970s and early 1990s (Kagarise Sherman and Morton 1993). The species is still distributed over most of the original range, and many populations have active breeding and recruitment (Shaffer et al. 2000), but several studies indicate that the species has declined in or disappeared from approximately 50-70 percent of the sites or general locations from which recorded (Jennings and Hayes 1994; Drost and Fellers 1996). A USFWS (2000, 2002) review found additional evidence of declines in distribution and abundance (NatureServe 2012).

Recent monitoring results for the period 2002 to 2009 indicate that Yosemite toad was estimated to occur in only 12 percent of the watersheds with known toad presence prior to 1990. In addition, monitoring of two watersheds indicated that “…adult male population abundances were generally less than 20 males and some meadows had very low abundances. Numbers of egg masses were similarly small” (USDA Forest Service 2012).

The cause of decline is uncertain, but activities potentially impacting the Yosemite toad and its habitat include livestock grazing; commercial and recreational pack stock grazing; recreational use of meadows; hiker and stock trail development and use; predation from introduced non-native fish species; herbicide and pesticide applications; pesticide drift from Central Valley agricultural areas; drift of automobile exhaust pollutants; disease as a result of fungal, bacterial, and other parasitic infections; long-term drought and climate change; and, possibly, recent increases in UV radiation (USDA Forest Service 2004).

**Distribution and Ecology**

The Yosemite toad is endemic to California, specifically a 130-mile long stretch of the Sierra Nevada from the Blue Lakes region north of Ebbetts Pass (Alpine County) south to 3 miles south of Kaiser Pass in the Evolution Lake/Darwin Canyon area (Fresno County) (Jennings and Hayes, 1994).

The Yosemite toad occupies the upper montane to subalpine zone, below the timberline from 5,000 to 11,000 feet of elevation. Yosemite toads are typically associated with high montane and subalpine vegetation in relatively open wet meadows surrounded by forests of lodgepole or whitebark pine. “The Yosemite toad breeds in late spring in areas of shallow water such as wet meadows, margins of ponds and lakes, and slow-moving streams. Breeding usually only lasts 1–2 weeks after which adults typically move to upland areas. Eggs and larvae develop in the shallow water areas and metamorphosis occurs by late summer of the same year. Adults tend to breed in a single site and appear to be highly philopatric, although individuals can move between breeding areas (Liang, pers. obs.). Breeding sites exhibit variation in year-to-year occupancy and some sites are consistently occupied while others are intermittently occupied” (Liang and Stohlgren 2011).

Previous estimates of movement distances by post-breeding toads have been fairly low (20 feet; Mullally 1953), but more recent studies indicate that toads can move significant distances (mean of 275 meters and as much as 1.2 kilometers) into upland forested areas (Martin 2008, Liang 2010). Martin (2008) estimated home range at approximately 8,460 m² (2.1 ac), while Liang (2010) estimated mean home range of 27,430 m² (6.8 ac), and
noted female home range was more than 1-1/2 times larger than males. Yosemite toads seek cover during non-breeding seasons (approximately August to March) in abandoned rodent burrows (Jennings and Hayes 1994) or by moving into adjacent forested areas (CDFG 2005).

Liang and Stohlgren (2011) evaluated habitat conditions at consistently occupied and intermittently occupied sites in the southern Sierra Nevada. Their modeling results indicate that “that the distribution of the entire population was highly predictable, and associated with low slopes, specific vegetation types (wet meadow, alpine-dwarf shrub, montane chaparral, red fir, and subalpine conifer), and warm temperatures. The consistently occupied sites were associated with these same factors, and also highly predictable. However, the intermittently occupied sites were associated with distance to fire perimeter, a slightly different response to vegetation types, distance to timber harvests, and a much broader set of aspect classes.” (Liang and Stohlgren 2011). The maximum probability of occurrence was associated with a distance of approximately 300 feet from fire perimeters or timber harvest. Liang (2010) use radio telemetry to follow the movements of toads and examined habitat associations at a fine scale. The study found that “Yosemite toads used terrestrial environments extensively and were found throughout the mixed-conifer forest. Burrows were the most commonly used microsite but other protective cover such as logs, rocks and tree stumps were also used. The locations occupied by Yosemite toads in the terrestrial environment were more open with less canopy and fewer woody species than surrounding areas” (Liang 2010).

Recently published studies of livestock grazing impacts on Yosemite toad found no detectible effects of grazing treatment effect on Yosemite toads or their most preferred habitats within meadows, no benefits from partial meadow fencing, and concluded that toad occupancy and survival are more directly correlated with meadow wetness than the intensity of cattle use (McIlroy et al. 2012, Roche et al. 2012a and 2012b). Primarily this resulted from spatial partitioning within meadows, with cows favoring drier sites for grazing and toads favoring wetter sites.

The studies to date have only tested the effects of altered grazing practices within local patches of meadows (e.g. trampling of toads by cattle), but did not test the larger-scale question of whether meadow alterations by grazing adversely impact toads (Scurlock and Frissell 2012). For example, where long-term grazing has caused or contributed to channel downcutting and water table lowering in meadows, then grazing renders meadows reduce wettedness of meadows, favoring cattle grazing at the direct expense of toad habitat on wetter sites. Contrary to media reports, this does not necessarily mean that cattle do not adversely impact toads; it may mean the impact is manifest at a larger scale and longer time frame, where the cumulative effect of grazing is to desiccate meadows, rendering toad habitats more vulnerable to climate and weather variability (Id.).

It remains unknown whether hydrological functions in degraded meadows can be substantially recovered while sustaining livestock grazing. But the data from these studies suggest a clear tradeoff: with future meadow restoration and hydrologic recovery, either prime grazing habitat will decline, or overlap between toads and cattle could increase as meadow wetness increases and toad populations benefit.

**Desired Condition**

- Remaining population centers are stabilized and numbers of individuals are increasing.
- The quality and amount of habitat is increasing.
- Existing population centers have expanded into suitable habitat.
- Increase in overall population numbers and reestablishment into historical range

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Objectives

- Eliminate impacts and stressors occurring in meadow systems and adjacent upland habitats suitable for Yosemite toad.
- Protect occupied Yosemite toad habitat (areas with standing and slow moving water - wet meadows, lakes, and small ponds, as well as in shallow spring channels, side channels of streams, and sloughs).
- Restore potential habitat.
- Restore and protect suitable Yosemite toad breeding habitat (e.g., edges of meadows, seasonally flooded meadows, slow-flowing shallow spring channels, and runoff streams).
- Maintain upland connections between all known populations to promote genetic diversity.
- Enhance and protect the wettable areas adjacent to and within occupied meadows and ensure that activities around and within such meadows do not contribute to drying, chiseling or compaction of the important habitats.

Conservation Measures

- Eliminate livestock grazing in the entire meadow system for meadows occupied by the Yosemite toad.
- Eliminate commercial and recreational pack stock grazing in occupied Yosemite toad meadows.
- Decommission unnecessary roads or roads that degrade meadow hydrology and function in Yosemite toad habitat and ensure that existing roads or trails do not contribute to habitat degradation.
- Delineate a Yosemite toad land allocation that includes all occupied meadows, logical connecting habitat among meadow, and include habitat that may not be consistently occupied. Use Liang and Stohlgren (2011) and other appropriate suitability models to support the delineation.

Table A-5. Land allocations specific to Yosemite toad conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yosemite Toad (YT)</td>
<td>Habitat around sites with YT including wet meadows with standing water and saturated soils, streams, springs, important upland habitat, and habitat identified as “essential habitat” in the conservation assessment for the Yosemite toad.</td>
<td>Provide habitat conditions to support successful reproduction and persistence. Maintain hydrologic function of meadow system. Limit human uses in areas not currently in excellent condition.</td>
</tr>
</tbody>
</table>

- Design activities in uplands areas that may support Yosemite toad to avoid disrupting habitat and killing toads during times when Yosemite toads are most likely to be migrating.
- Avoid vegetation management activities in the uplands or in meadows that threaten any life stage of Yosemite toad until population centers are stable and increasing.
- Restrict recreational use of meadows (e.g. hiking trails), especially during the breeding season.
- Avoid direct application of pesticides within 1,000 feet of Yosemite toad habitat.
- Reduce the use of pesticides in the valleys downwind from the Sierra Nevada and Yosemite toad habitat.
- Eliminate exotic fish from toad habitat.
- Convene a multi-agency and stakeholder group to develop a conservation strategy to protect and recover Yosemite toad.
- Undertake research and monitoring to assess the causes of population decline, improve knowledge of habitat us and population dynamics, and support development of additional conservation measures.
References


Center for Biological Diversity, Natural History of the Yosemite Toad, http://www.biologicaldiversity.org/species/amphibians/Yosemite_toad/natural_history.html


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MAMMALS

This section provides species accounts and conservation recommendations for the following mammals (Table A-6).


<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ursus americanus</td>
<td>Black bear</td>
<td>SAR-M</td>
</tr>
<tr>
<td>Martes pennanti</td>
<td>Pacific fisher</td>
<td>FWBP, CC</td>
</tr>
<tr>
<td>Martes caurina3</td>
<td>Pacific marten</td>
<td>FSS, CSSC, MIS</td>
</tr>
<tr>
<td>Gulo gulo</td>
<td>Wolverine</td>
<td>FSS, CT</td>
</tr>
</tbody>
</table>

CT California Threatened Species
CC California Candidate for listing
CSSC California Species of Special Concern
FSS Forest Service, Region 5, Sensitive Species
FWBP Federal “Warranted but Precluded”


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Black Bear (*Ursus americanus*)

**Issue Statement**

Black bears are common in California and can be found mostly in mountainous areas over 3,000 feet in elevation. The black bear population has been steadily increasing over the past 25 years and in 2008 there were an estimated 37,518 black bears in California. The California Department of Fish and Game consider the black bear an important component of California's ecosystems and a valuable resource for the people of California (California Department of Fish and Game 2012).

Black bears are very opportunistic eaters and consume a diet that consists of grasses, roots, nut and berries, insects, fish, and mammals (including carrion). They are one of the most adaptable of all large carnivores and will readily use anthropogenic food sources like garbage and pet food (Beckmann and Berger 2003). Black bears will raid trash cans, break into cars and houses, and steal food from campers, which often leads to conflict and can lower human tolerance of the species. Conflict with humans is a critical and growing management issue throughout the species range (Baruch-Mordo et al. 2008), including the Sierra Nevada.

**Distribution and Ecology**

The Sierra Nevada subpopulation encompasses the Sierra floristic province and extends from Plumas County south to Kern County (California Department of Fish and Game 1998). Black bears inhabit the entire region. Forty percent of the statewide black bear population inhabits the Sierra Nevada but this subpopulation tends to be less dense with between 0.5 and 1.0 bears per square mile (Sitton 1982, Grenfell and Brody 1983, Koch 1983). Over two-thirds of the bear habitat in the Sierra Nevada is administered by the U.S. Forest Service and two large National Parks are located within this region (California Department of Fish and Game 1998).

Black bears occupy a variety of habitats; however, bear populations are densest in forested areas that contain a variety of seral stages. Bears prefer habitats with both vegetative and structural diversity because these environments provide alternate food resources when other foods are in short supply. Food availability for black bears has been strongly correlated to reproductive success in female bears (Jonkel and Cowan 1971, Piekielek and Burton 1975, Rogers 1987). Vegetation and structural diversity not only fosters greater survival of existing bears, but also provide for increased reproduction. Black bears prefer mountainous habitats like montane hardwood, montane chaparral, and mixed conifer forests. They will use other habitat types such as grassland but to a much lesser degree.

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Many of the important food plants (e.g., manzanita, oaks) utilized by black bears grow primarily in forest openings. Controlled burns or other management strategies aimed at creating a mosaic of forest openings can be beneficial to black bears by providing abundant food resources in close proximity to cover. Retention and recruitment of snags and woody debris provide den sites and potential food source (colonial insects). Fire suppression resulting in even-aged stands with less diversity of vegetation and ecosystem structure decreases habitat value for black bears (California Department of Fish and Game 1998). Female bears require secure, dry den sites for birthing and raising cubs. Dens have been found in slash piles, under large rocks, and even on open ground, but the most secure and thermally protective den sites are associated with large trees.

**Desired Condition**

- Quality home ranges and dispersal habitat are distributed across the landscape in a pattern that allows the movement of black bear and thereby facilitates breeding among individuals.
- Large blocks of suitable habitat and core areas within these blocks where bears encounter few humans.
- The natural distribution, abundance, and behavior of the black bear population are restored.
- Human-bear interactions and conflicts are managed and reduced.
- Fragmentation of black bear habitat has been reduced through the closure and obliteration of roads and the net reduction in total road density.
- Quality denning sites exists in adequate quantity across the landscape.
- Formal system of monitoring and research on black bear behavior, habitat selection and use, and human-bear interactions has been established.

**Objectives**

- Forest ecosystems are managed through the use of controlled and natural fire (let-burn policy) to create a mosaic of openings with adequate vegetative and structural diversity.
- Bear management programs are instituted in the urban-wildland interface to reduce the incidence of human-bear interactions and conflicts.
- Vegetation management (e.g., fuel reduction, forest restoration) projects are designed to maintain adequate denning sites and increase vegetative and structural diversity.
- Forest fragmentation is reduced by closing/decommissioning key roads and reducing overall road density in suitable bear habitat.
- Monitoring of black bear status is undertaken annually and management direction should adapt to data acquired by monitoring efforts.
- Habitat corridors that provide adequate cover and resting areas are maintained to provide movement between suitable black bear habitat patches.
- Black bear management plans will be completed by 2020.

**Conservation Measures**

- The recommendations in the conservation strategy that address old forest ecosystems, riparian and aquatic ecosystems, fire and a disturbance process, and structural diversity of plant communities conservation are expected to provide direct benefits to the conservation of black bear.

- Ecological restoration projects (e.g., fuel reduction, controlled burning) shall include black bear management strategies such as:
  a. Retaining large snags and woody debris as den sites and potential food sources, and
b. Creating a mosaic of forest openings to provide abundant food resources in close proximity to cover.

- Reduce fire suppression activities outside the wildland-urban interface and promote controlled and natural burns to facilitate vegetation and structural diversity.

- Remove barriers (e.g., roads, human infrastructure and developments) to black bear movement within and between suitable habitats.

- Create large blocks of suitable habitat by removing key un-needed roads and reducing the overall road density to less than 1 mile/miles² in high quality habitat (Wildlands CPR 2012).

- Reduce human-bear interaction by increasing public education and outreach, providing bear-safe trash receptacles for homes, and bear-proof containers at public recreation sites.

References


Pacific Fisher (*Martes pennanti*)

**Issue Statement**

Now essentially confined to two populations in the southern Sierra Nevada, California, and northern California-southern Oregon; unregulated trapping for furs, predator bounties, and extensive, lethal predator control programs likely impacted fishers for nearly two centuries and were exacerbated by loss and fragmentation of habitat from urban growth and development, forest management activities, and road construction; the remaining two populations are threatened with extirpation due to their small size and isolation. There is substantial information indicating that the interaction of all the factors above may cause the populations of fishers in their west coast range to become significantly at risk of extirpation. (NatureServe 2012)

It has been estimated that there are less than 300 adult fishers in the southern Sierra Nevada (Spencer et al. 2011). Fishers have declined historically from over-trapping, population isolation due to forest fragmentation, habitat alteration, poisoning, and loss of prey species resulting from rodent and predator control (Lofroth et al. 2010). Zielinski and Mori (2001) identified several possible reasons for the failure of the fisher to reoccupy areas in the Sierra Nevada since initial population decline: (1) insufficient habitat exists for dispersing animals to found new populations, (2) existing populations are too small to provide sufficient numbers of dispersing animals to recolonize the vacant areas, or (3) dispersal habitat is of poor quality, or is interrupted by non-forest land uses and roads, and dispersing animals succumb or are killed during dispersal.

**Distribution and Ecology**

In eastern California, the fisher historically ranged throughout the Sierra Nevada, from Greenhorn Mountain in northern Kern County northward to the southern Cascades at Mount Shasta (Grinnell et al. 1937). It is considered that they now occur primarily in a continuous band of low to mid-elevation forest on the western slope of the Sierra Nevada, rarely ranging above 7,000 feet. Fisher have rarely been detected north of the Merced River in the last 20 years (California Department of Fish and Game 2010). Recent surveys indicate that fishers appear to occupy less than half the range they did in the early 1900s in California. Currently, there are two remnant populations that are separated by approximately 260 miles (Zielinski et al. 1995), almost four times the species’ maximum dispersal distance as reported by York (1996) for fishers in Massachusetts. Failure to detect fishers in the central and northern Sierra Nevada, despite reports of their presence by Grinnell et al. (1937) and reports from the 1960s collected by Schempf and White (1977), suggests that the fisher population in this region has declined, effectively isolating fishers in the southern Sierra Nevada from fishers in northern California. Knaus et al. (2011) found that genetic analysis of the northern California population has been isolated from the population in the Sierra Nevada for more than a thousand years. Although these results indicate that the populations have been separated for a lengthy period of time, it is not known how long fishers have been extirpated from the area between Lassen National Forest and Yosemite National Park, i.e., the “gap” in the Sierra Nevada. The information in Grinnell et al. (1937) and others’ incidental sightings suggest that fishers were present in this area during the 20th century.

Fishers are found in low to mid-elevation forests (3,500 to 7,000 feet). Their distribution is limited by elevation and snow depth; they are unlikely to occupy regions where elevation and snow depth act to limit their

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movements. Fishers select for conifer or conifer-hardwood mixed forests with dense canopy coverage at all spatial scales, and large trees, snags, and downed logs (Powell 1993, USDA Forest Service 2006, Lofroth et al. 2010). Studies in the southern Sierra Nevada (e.g., Mazzoni 2002, Zielinski et al. 2004) showed that a significant, although not large, percentage of home range area was composed of stands of large trees generally greater than 61 cm diameter breast height (dbh) and relatively dense canopy coverage (>50 percent). Fishers are more likely to be detected in larger forested stands (>125 acres), especially stands with high connectivity (Rosenberg and Raphael 1996). In the southern Sierra Nevada, fishers prefer areas with oak, which are used for resting and denning (USDA Forest Service 2006). Powell (1993) suggested that forest type is probably not as important to fishers as the vegetative and structural aspects that lead to abundant prey populations and the reduction of fisher vulnerability to predation (USDI Fish and Wildlife Service 2004). Fisher populations require large forested areas with fairly dense canopy cover that provides productive prey habitat, protection from predators, and snow cover. Trees with cavities and the presence of suitable denning and resting structures appear to be key resources at the microsite scale within these forested areas and generally the largest of such elements are selected for denning or resting (Purcell et al. 2009). Fully functioning ecological processes of decay and disease are required to develop the den and rest structures and microsite characteristics over time. Such characteristics are more prevalent in, but not limited to, older forests (USDA Forest Service 2006).

Based on an evaluation of habitat use, Spencer and Rustigian-Romsos (2012) developed habitat models for fishers in the Sierra Nevada (Figure A-9). This assessment developed models for general use, denning and movement based on habitat associations from the literature (Id.). At the present time, higher quality habitat north of the Merced River is not occupied. “This may be due to the combination of dispersal filters associated with Yosemite Valley (steep slopes, Merced River, heavy traffic) and high mortality in occupied areas south of the Merced River, which probably limits the number of potential dispersers (Spencer et al. 2011, Carroll et al. In Press).” (Id.) Spencer and Rustigian-Romsos found, based on fisher use of areas not reflected as higher probability in the models, that predicted habitat was likely underrepresented in the Sequoia-Kings Canyon National Park and the Kern Plateau and recommended further evaluation of these areas. The map below (Figure A-9) illustrates the distribution of predicted core habitat, high value habitat, and areas important for movement throughout the Sierra Nevada. Additional maps presented in Spencer and Rustigian-Romsos (2012) (and data available from the Conservation Biology Institute) provide a closer view of the arrangement of habitat in the southern Sierra Nevada.
Figure A-9. Potential habitat and movement corridors for Pacific fisher (Spencer and Rustigian-Romsos 2012).
Threats

Naney et al. (2012) in an assessment of threats through the West Coast range of Pacific fisher found that the most immediate and challenging threat was their small population size and the isolation of the three West Coast populations. “Small, isolated populations are inherently at higher risk of extirpation owing to stochastic phenomena and uncertainty” (Id.). The assessment concluded that management activities that resulted in loss of important structures for denning and resting, loss of overstory cover, and reduction in recruitment rate of future forest structure threatened the persistence of fishers (Id.). Furthermore, “the relatively narrow distribution of suitable, mid-elevation forests they occupy elevates the potential for populations to be fragmented by fires or management actions” (Spencer and Rustigian-Romsos 2012).

Previous studies have found that forest practices resulting in the conversion of conifer-dominated forest to hardwood-dominated forest may be detrimental to fishers, because of the loss of denser canopy structure (Buck et al. 1994). Likewise, fishers are negatively associated with clearcuts and forested stands significantly edged by clearcuts. Timber harvest can fragment fisher habitat, reduce habitat size, or change the forest structure making it unsustainable for fishers. Logging and development have caused severe loss and fragmentation of old-growth forests. Stand replacing wildfires, as well as management activities designed to prevent such fires by reducing the amount and continuity of forest fuels, all can result in significant reduction in suitable habitat needed to provide for fisher viability.

Recent studies also have begun to evaluate the causes of mortality for fishers in the southern Sierra Nevada. Mortality from predation has been identified as a leading cause of death in the SNAMP (Sweitzer 2011) and Kings River study (Thompson et al. 2011a). Road related losses are also significant in areas, such as the SNAMP study, affected by major highways (Sweitzer 2011). Mortality related to poisoning is an emerging threat to fishers. Recent results from blood samples and post-mortem evaluations of fishers indicate that contamination from anticoagulant rodenticides is widespread within the fisher’s range in California (Gabriel et al. 2012). The study found that four fisher deaths, including a lactating female, were directly attributed to anticoagulant rodenticide toxicosis. The study documented the first neonatal or milk transfer of these poisons to a fisher kit. These rodenticides pose both a threat of direct mortality or fitness risk to fishers, and a significant indirect risk to these isolated populations. The relationships between potential reduced fitness from rodenticide exposure, pressure from predation, and the effects of habitat alteration are not well known at this point; it is possible that these factors interact synergistically to reduce fitness.

A number of recent studies have focused on habitat use at various scales. A primary focus of these studies has been the development of tools that could support designing vegetation management projects and evaluating the effects of management treatments on fishers and fisher habitat. Spencer et al. (2011) developed a habitat model for fishers in the southern Sierra Nevada and coupled this model with a population model to assess the condition of habitat across the landscape and to estimate how many fishers might possibly occupy the space. This habitat model was expanded to include a model for denning habitat and an evaluation of movement habitat (Spencer and Rustigian-Romsos 2012; see partial results in Figure A-9). Thompson et al. (2011b) developed an analysis tool to evaluate the existing condition and post-treatment condition of a home range and related this to occupancy of the home range. Using relationships such as these, the paper suggests that this tool could be used to design vegetation management projects and assess their effects on habitat conditions. Lastly, Zielinski et al. (2010) developed a tool to assess habitat condition at a stand level and the effects of management on habitat conditions. This tool incorporates a common vegetation model to evaluate the changes in habitat conditions from timber harvest. The next step in the development of tools such as these is to integrate these tools into a multi-scale decision support tool to assist in conservation planning for fishers.

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**Desired Condition**

In the desired future condition, the extant populations of fisher have expanded. Expanded populations in the Sierra Nevada provide a source for natural dispersal into formerly occupied range. Expanded populations outside the Sierra Nevada provide animals for future reintroductions and reflect a stable population on the West Coast of North America. Suitable habitat corridors facilitate active dispersal into former ranges. The landscape contains sufficient amounts of continuous, canopy-covered forest with hardwood trees for denning and felled logs and snags for resting sites. Fishers have been successfully reintroduced to areas with appropriate habitat conditions and a low likelihood of negatively affecting Pacific marten (*Martes caurina*). There is a reduction in anthropogenic hazards, like roads, use of rodenticides and trapping.

**Objectives**

- Ensure habitat connectivity for old forest associated species by managing large contiguous areas of late-successional forest linked by high capability habitat for dispersal.
- Manage human caused and naturally ignited fires, and post-fire forest landscapes, to maximize ecological benefits for fishers.
- Increase the connectivity of suitable habitats between southern Sierra fisher populations and the central and northern Sierra Nevada.
- Protect and restore black oak as a significant component of mixed-conifer forest ecosystems.
- Mitigate the anthropogenic effects of forest management activities.
- Identify and remove barriers to dispersal (e.g., highways and open forest areas).
- Improve wildlife road-crossing options on state and rural roads
- Complete carnivore detection surveys at the landscape level to:
  a. Describe the geographic range of fishers and other mammalian carnivores in the region,
  b. Collect data to develop and test regional habitat models for fishers and other carnivores,
  c. Provide baseline data for monitoring changes in population status for these carnivores,
  d. Understand the influence and interaction of habitat factors, community ecological factors, and anthropogenic effects on the distribution of carnivores in the region.

**Conservation Measures**

- Continue funding the fisher research associated with the Sierra Nevada Adaptive Management Project and the Kings River Fisher Study through at least 2016.
- Undertake a review of research needs for fishers in the southern Sierra Nevada, engage fisher scientists about research needs, and identify and fund a research program to support fisher conservation.
- Convene a group of scientists, specialists, managers, and stakeholders to develop a conservation strategy for fishers in the Sierra Nevada (Spencer and Rustigian-Romsos 2012).
- Retain and enhance remaining old-growth and late-successional forest stands.
- Develop a conservation strategy that establishes a series of fisher population centers that are interconnected by areas of habitat suitable for dispersal. Use the habitat models developed by Spencer and Rustigian-Romsos (2012) to support the conservation strategy.
- Until a fisher conservation strategy is adopted for national forests in the southern Sierra Nevada follow the recommendations for forest management in the conservation strategy, including limits to timber harvest, provisions for over-fisher cover, large wood and large snags, and establishment of den buffers with limited management allowed.
- Develop marking guidelines to achieve retention of structures important for resting, denning, and hiding cover from predators.
- Ensure that suitable resting structures are widely distributed throughout home ranges of fishers and spatially interconnected with foraging habitats. Maintain, enhance, and do not degrade all suitable resting and denning habitat until a regional conservation strategy is adopted.
- Install over- or under-passes in stretches of highways with high fisher mortality rates.
- Reduce road density in fisher habitat.
- Design fuels reduction and restoration treatments to minimize reductions in canopy cover and canopy layering. Tree removal should focus on smaller diameter, shade-intolerant species.
- Reestablish and enhance patches of lush layered ground vegetation, snags, and fallen logs to provide conditions for abundant prey.
- Limit forest management activities in suitable denning habitat to avoid disturbance to individual denning fishers and direct take of denning individuals (e.g., limited operating period during denning seasons, March 1 to June 30) (Spencer and Rustigian-Romsos 2012).
- Create a den buffer (700 acres) around all known den sites. Limit activities within the den buffer to treatment of surface and ladder fuels or managed fire that results in low levels of mortality (less than 10 percent) in the dominant and co-dominant trees (Table A-7).
- Define objectives for use fire in constrained travel corridors to achieve low severity fire effects and to avoid stand replacing effects (Spencer and Rustigian-Romsos 2012).
- Avoid post-disturbance logging in fisher habitat (Naney et al. 2012).
- Form an inter-agency focus group to:
  a. Update pesticide labels to restrict over the counter use.
  b. Investigate the supply chain for rodenticide to marijuana plantations, and trace sources, and take regulatory actions for distribution pathways.
- Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada on fishers. Determine the scale at which heterogeneity benefits fishers. For example, evaluate need for patches of multistory stand structure in a treatment unit versus leaving 15-25 percent of units untreated.

Table A-7. Land allocations specific to Pacific fisher conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Carnivore Den Sites</td>
<td>Den site buffer (700 acres for fisher; 100 acres for marten) designated around known maternal or natal dens.</td>
<td>Limit disturbance during denning (limited operating period). Retain habitat conditions that support denning. Limit vegetation management to reducing surface and ladder fuels to reduce fire risk until new science suggests otherwise. Restoration treatments do not remove larger white fir or incense cedar in these areas.</td>
</tr>
</tbody>
</table>

References

California Department of Fish and Game 2010. Report to the Fish and Game Commission: A status review of the fisher (*Martes pennanti*) in California. California Department of Fish and Game, Sacramento, California, USA.


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USDA Forest Service 2004. *Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Statement*. Pacific Southwest Region, Vallejo, California, USA.

USDA Forest Service 2006. A conservation assessment for fishers (Martes pennant) in the Sierra Nevada of California. Pacific Southwest Region, Vallejo, California, USA.


Pacific Marten (*Martes caurina*)

**Issue Statement**

The marten’s range is broadly continuous across boreal forests of Alaska and Canada, but in the western United States its distribution is limited to mid and high elevation coniferous habitats. Population isolation has occurred in Oregon, Washington and California where marten were found in only 5 percent of their historic range (Zielinski et al. 2005). This substantial change in distribution is most likely due to habitat loss because it occurred after hunting was outlawed in the 1950s (Buskirk and Ruggerio 1994). In the northern Sierra Nevada there is an apparent gap in the marten’s distribution that is also likely related to logging of old forests (Zielinski 2004, Zielinski et al. 2005). Here, distribution appears concentrated in unmanaged forests of wilderness and National Parks (Zielinski et al. 2005, Rustigian-Romsos and Spencer 2010). Improving connectivity between high elevation old forests is a conservation priority for marten across the West, especially in the northern Sierra Nevada and Lassen region (Rustigian-Romsos and Spencer 2010).

Marten are closely associated with old forests because they provide safety from predators while resting and rearing young, as well as a diversity of prey throughout the year. Their habitat use is stratified by season, with upslope movement occurring in summer. Riparian areas and meadow edges also represent key foraging habitat in the Sierra Nevada (Spencer et al. 1983). Marten have high energetic needs and therefore foraging habitat is important year-round (Buskirk and Harlow 1989).

**Distribution and Ecology**

*Elevation Range:* The marten’s elevation range in the Sierra Nevada has been variously described as ranging from 5,500-10,000 feet with marten occurring most often above 7,200 feet (USDA Forest Service 2001), and as ranging from 3,400-10,400 feet in the northern Sierra Nevada, with averages around 6,600 feet, and ranging from 4,000-13,100 feet in the southern Sierra Nevada, averaging 8,300 feet (Schempf and White 1977).

*Habitat:* Marten require structural attributes of old forests including dense overhead cover and coarse woody debris (large snags and downed logs). They are associated with relatively contiguous landscapes of old forest. Martens in Maine, Utah, and Quebec are associated with landscapes containing more than 70–75 percent mature forest (Bissonette et al. 1997, Chapin et al. 1998, Potvin et al. 2000). Similarly, Hargis et al. (1999) found that marten selected landscapes with no more than 25 percent of landscape lacking in old forest cover. Whether this applies to small openings, such as group selection, and not just to large openings such as clearcuts is an issue that has not been specifically addressed. Additional information is expected on the response of martens to openings as a result of research being completed by Katie Moriarty on the Lassen National Forest.

Complex physical structure near the ground is also an important habitat element (Buskirk and Ruggiero 1994, Buskirk and Powell 1994, USDA Forest Service 2001). In addition to large snags and downed logs, vertical live and dead tree boles also provide significant habitat structure (Slauson and Zielinski 2008), as does shrub cover. Hargis and McCullough (1984), in their study in Yosemite National Park, found that marten strongly selected for low overhead cover. Slauson et al. (2006), in their study in northwestern California, found that “dense shrub cover was the most consistent habitat element at sites selected by martens.” (p. 465). Slauson and Zielinski

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(2007) reported a strong marten preference for dense (greater than 80 percent) shrub cover in the same study area. Buskirk and Ruggiero (1994) concluded that the marten’s “preference and apparent need for structure near the ground, especially in winter, appears universal,” likely due to protection from predators, access to subnivean (below snow) space, and thermal regulation (p. 22).

Marten are known to utilize a wider range of habitats than old forests, particularly riparian areas and meadow edges (Spencer et al. 1983). Their habitat use also appears to be stratified by season, with use of lower elevation mixed conifer in the winter and higher elevation red fir forests in the summer (Buskirk and Powell 1994, Buskirk and Ruggiero 1994, Rustigian-Romsos and Spencer 2010).

a) Reproductive and Resting Habitat: Typical rest site structures include the largest diameter live trees (red fir, lodgepole, and riparian associations), snags, platforms, and logs over 30” dbh (Spencer 1987, Martin and Barrett 1991, Slauson and Zielinski 2008). Atypical rest sites include man-made structures (wood piles, buildings) (Martin and Barrett 1991, Ellis 1998). Winter rest structures are frequently subnivean (logs, stumps and snags) (Slauson and Zielinski 2008).

Natal dens are typically found in cavities in large trees, snags, stumps, logs. Burrows, caves, rocks, or crevices in rocky areas are used less frequently (USDA Forest Service 2001). Den and rest site availability is so limited; it may also limit the marten’s population (Ruggiero et al. 1998, Bull and Heater 2000). Indeed, resting and denning structures take over 100 years to develop and impacts to marten from their removal would extend over the next century.


- Late successional, old forests
- CWHR 5D and 6
- Canopy cover of at least 50 percent, mostly 60 percent and greater on the Westside Sierra Nevada
- Presence of large snags and logs on ground (coarse woody debris)

Bull and Blumton’s (1999) study evaluated the impacts canopy cover reduction on marten and marten prey in eastern Oregon and found marten avoided areas with less than 50 percent canopy cover. Similarly, Bull and Heater (2000) suggest marten avoid stands with less than 50 percent canopy cover. Many marten experts report that martens select 60 percent or greater canopy cover for resting and denning (Ellis 1998, Ruggerio et al. 1998, Slauson and Zielinski 2008). Resting canopy cover requirements may be lower for marten in winter, when they use stands with canopy cover as low as 30 percent. However, key winter prey species such as Douglas and flying tree squirrels are associated with closed-canopy old forest conditions (Slauson and Zielinski 2008).

On the eastside of the Cascades and Sierra Nevada, marten show similar habitat associations. In one study, rest sites were generally characterized by large trees, with nearly half CWHR 5/6 and 40 percent CWHR 4 (Kucera 1996). Bull and Heater (2000), in mixed conifer forests of eastern Oregon, found that “Large-diameter hollow trees and logs, accumulations of coarse woody debris, and trees with brooms provided important habitat for resting sites”; the average diameter of trees with den structures was 33” dbh.

Coarse woody debris (large snags and downed logs) is also a significant resting and denning habitat element. This structure is especially important in winter, when it provides subnivean tunnels and access holes. Even low tree branches that reach toward the ground through snow provide important subnivean access. Sherburne and Bissonette (1994) found that when coarse woody debris covered a greater percent of the ground, marten use also

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increased. One study from the Cascades of California recommend 26.6 logs larger than 28 cm within 35 meters of rest sites, which converts about 27 large logs per acre (Slauson and Zielinski 2008). On field trips regarding marten studies being undertaken on the Lassen National Forest, Moriarty and others described the importance of jackstraw logs and high stumps for denning structures. Research on the Inyo National Forest, in eastside Jeffrey pine, similarly found that rest sites in trees were typically in large structures, averaging 40” dbh. (Kucera 1996, Kucera 2004). Rest sites are located where snag, down log and basal area densities are higher than surrounding forest (Kucera 2004). Older growth forests provide accumulated coarse woody debris necessary to enable marten to forage effectively during the winter.

Marten need many rest and nesting structures within each home range. Slauson and Moriarty (2010) report low rates of resting structure reuse in their research review. In fact, “Marten use resting sites daily, and availability of appropriate sites within their home ranges is essential to their well-being” (Martin and Barrett 1991, p. 41). Marten re-use of rest sites may also be stratified by season. In the summer, it appears as though marten use many novel rest sites within a home range. Martin and Barrett (1991) found that 15 percent of rest sites were reused, some on multiple occasions. Similarly, Spencer (1987) reported 12 percent re-use of non-subnivean sites. Conversely, during winter, 42 percent of subnivean rest sites were reused (Id). Spencer concludes that

“A miscellany of resting sites scattered throughout the home range, each convenient to primary foraging patches, allows a marten to choose a resting site suitable to current conditions with a minimum of travel” (620-21).

b) Dispersal Habitat: There is relatively little research on marten dispersal. Bull and Heater (2001) report juvenile marten dispersed an average of 20 miles. Movement of up to 43 miles has been reported (Slauson and Moriarty 2010). Johnson et al. (2009) found that marten survival was inversely associated with dispersal distance, with mortality rates twice as high in clear cuts compared to forests. Buskirk and Powell (1994) conclude that marten will travel through forests that are not preferred habitat, but for how long and separated by what amount of higher quality habitat is not known.

c) Habitat Modeling: Rustigian-Romsos and Spencer (2010) developed a habitat model for the northern Sierra Nevada and southern Cascades region. The models show key areas where marten population cores and travel corridors are predicted. Authors introduce the figure as follows:

…marten cores and connectivity areas [are] (delineated as 5-km-wide normalized least-cost corridors). Habitat connectivity does not appear to be greatly limiting for martens south from Plumas National Forest, but movement corridors are relatively long and constrained from Plumas National Forest north, where relatively xeric, lower elevation, and disturbed habitats separate the higher-elevation red fir forests preferred by martens.

Spencer and Rustigian-Romsos (2012) expanded their study of the Mount Lassen area to include the Sierra Nevada region to the south. Using a similar method of occupancy and movement modeling they modeled potential habitat and movement corridors for the inland mountains of California (Id.; Figure A-10). Similar to their earlier work, they found that:

In the northern 1/3 of the study area, management should focus on protecting habitat quality within and around the perimeters of the core populations (Mount Shasta-Medicine Lake region; Mount Lassen-Swain Mountain-Thousand Lakes Wilderness region) and especially in and between the smaller cores, stepping stones, and connectivity areas between these regions, and between Mount Lassen and the more contiguous habitat core to the south (i.e., on the west slopes of the Plumas and Lassen National Forests).
(Spencer and Rustigian-Romsos 2012). Habitat distribution and availability was less limited in the southern two-thirds of their study region.
Figure A-10. Potential habitat and movement corridors for Pacific marten (Spencer and Rustigian-Romsos 2012).
Diet: Marten diet varies by season. In the summer key prey species include voles, ground squirrels, chipmunks, birds (Passerines and grouse), pocket gophers, deer carcasses, berries and insects (e.g., yellowjackets and others) (Buskirk and Ruggerio 1994, Slauson and Zielinski 2008). In the winter, key marten prey include Douglas tree squirrels, snowshoe hare, northern flying squirrels and deer mice (Slauson and Zielinski 2008). In a southern Sierra study, marten ate rodents (squirrels and voles), insects, hypogenous fungi and secondarily (less than 20 percent of diet) reptiles and birds (Zielinski et al. 1983, Zielinski and Duncan 2004).

Meadow voles (*Microtus* spp.) are a primary prey item throughout the year (Zielinski 1981). Voles require annual herbaceous thatch left over from the previous year for cover, typically 12-18” vegetation height in Sierra Nevada meadows (Greene 1995). Most publicly grazed Sierran meadows leave much to be desired for vole/marten habitat for a variety of reasons including over utilization by cattle permittees, hydrology of the meadow, and site capability. Although voles may proliferate in meadows, marten appear not to venture into meadows to hunt, but rather use riparian areas and edges along mixed conifer forest and meadows (Spencer et al. 1983, Hargis and McCullough 1984).

Reproduction: Pacific marten mate between June and August. Females gestate a fertilized egg over the winter and implantation of the egg in the uterus (delayed implantation) occurs in March. Marten kits are born in April. Females mate at 15 months and have their first litter by age 2. Females are solely responsible for raising young. They have a maximum of one litter per year and a range of 1-5 kits per litter, averaging 2-3 kits per litter. In years of environmental stress, pregnancy rates can be as low as 50 percent (Buskirk and Ruggerio 1994). Sexual dimorphism is strong, with males about 40 percent larger than females.

Predators: Mature forest loss makes marten vulnerable to predation at the home range and landscape scale (Slauson and Moriarty 2010). Documented predators of marten include coyote, fox, bobcat, golden eagle and great horned owl (Buskirk and Ruggerio 1994, Slauson and Moriarty 2010). Predators can utilize human-modified landscapes such as roads, managed forests and even snowmobile trails. For example, coyote follow snowmobile tracks over deep snow to hunt and/or compete with lynx (Kolbe et al. 2007). A similar impact is plausible for marten because unlike coyote, marten and lynx have similar foot adaptations for travel over deep unpacked snow where they would normally find coyote-free winter habitat.

Home Range: Mean home ranges in the Central Sierra Nevada are 960 acres for males and 801 acres for females (USDA Forest Service 2001). Marten home ranges are large relative to their body size, and vary to some extent based on prey availability and habitat type. For example, home ranges, including clearcuts, were 63 percent larger compared to home ranges in uncut forest in Maine (Buskirk and Ruggerio 1994). There is risk for marten with larger home ranges. Slauson and Zielinski (2008) report on a study that found marten home range size is inversely associated with survival and as home range increases so does the probability of predation. Johnson et al. (2009) found the same inverse relationship between home range size and survival.

Demography: Population estimates and trends are not available for marten in California. Hunting of marten has not been legal since 1954 (USDA Forest Service 2001). Declines in marten population size in the early twentieth century have been attributed to habitat loss, trapping and poisoning. More recently, logging has reduced habitat leaving populations isolated and poorly distributed (Buskirk and Ruggerio 1994, Slauson and Zielinski 2008).

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Threats

There are a variety of potential threats to marten and marten habitat, include logging, roads, population isolation, fire, livestock grazing, poisoning, recreation and climate change. Marten experts identify several factors that make martens slow to recover from population-level impacts (e.g., habitat loss, poisoning, and auto collisions): 1) specialization with old forest habitat; 2) low reproductive rates; 3) large home ranges (Buskirk and Ruggerio 1994 p.16; USDA Forest Service 2001, Slauson and Zielinski 2008).

Population Size/Isolation: Habitat loss is thought to constrain marten movements (Bissonette et al. 1989, Chapin et al. 1997, Hargis et al. 1999), and to the extent that marten populations become geographically isolated from one another, there is an increased risk to genetic variability and ultimately extirpation (Buskirk and Ruggiero 1994). Habitat modeling of marten populations by the Forest Service indicates that the likelihood of extirpation may increase disproportionately in response to decreases in available habitat.

A total of 39 fisher from northwest California were released into the northern Sierra Nevada outside Chico from 2009-2011 (California Department of Fish and Game 2012). Competitive and aggressive interactions are known to occur among fishers and martens at the margins of their ranges where they may overlap. Fishers transplanted from northwestern California are larger than fishers form the Sierra Nevada. Because of their increased size, these transplanted animals may pose an even greater threat as competitors or aggressors to marten living in the area.

Habitat Fragmentation/Habitat Loss: Marten are old forest specialists. Their habitat is fragmented and at risk in the Sierra Nevada. Fire and insects can be sources of habitat loss, however “because logging is unique among these disturbances in removing boles from forests, and because of the importance of boles in contributing physical structure to habitats, logging likely is more deleterious to habitat quality for martens than other disturbances” (Buskirk and Ruggerio 1994).

a) Logging: Logging poses a potential negative impact on marten when it reduces canopy cover below the desired 50-100 percent, or when diseased and deformed trees are removed. Such logging activity on public lands includes group selection, Defensible Fuel Profile Zones (DFPZs), thinning from below (or the middle), individual tree selection, and post-disturbance logging. Bull and Heater (2000, p. 184) discuss their concerns regarding impacts of fuel reduction logging on marten:

Large-diameter hollow trees and logs, accumulations of coarse woody debris, and trees with brooms provided important habitat for resting sites. The silvicultural practices of removing trees with brooms, removing hollow trees, and reducing fuels (coarse woody debris) to lower the risk of or damage by wildfire may negatively alter marten habitat.”

The impacts of logging practices such as DFPZs or thinning from below on marten habitat would likely depend on a variety of factors including remnant canopy cover (including low overhead cover), the extent of removal and retention of large structures, and the extent to which potential rest and den structures are protected (e.g., damaged and diseased larger trees). Classic, thinning from below and DFPZs would not appear to provide habitat for marten based on relatively low resulting canopy cover (40 percent or lower), lack of complex physical structure near the ground, removal of large trees, snags, and logs, and removal of diseased and deformed trees. DFPZs are expected to result in “relatively open stands” in which “the forest floor would usually be relatively open, with the exception of occasional large logs” (USDA Forest Service 1999, p. 2-20). However, practices such as retaining leave islands with higher canopy cover and higher shrub cover, retaining large snags and large downed logs, would appear to benefit marten.

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The Fish and Wildlife Service has expressed concerns that “marten may not move across linear DFPZs, limiting population expansion and colonization of unoccupied habitat … thus precluding future recovery options.” (USDI Fish and Wildlife Service 1999, p. 12). Similarly, the Forest Service itself has expressed concerns that DFPZs, especially in the red fir zone, “could create open forest conditions that are no longer suitable for marten, and are large enough to serve as potential barriers to movement” (USDA Forest Service 1999, p. 123). Whether DFPZs would create a barrier to marten movement has not been specifically researched and would likely depend on the resulting vegetation, width and location. Certainly, DFPZs and other logging located in the Lassen area and the Northern Sierra Nevada would raise utmost concern for marten in the region.

Ellis (1998) and Kucera (1996) (also discussed in the habitat section above) are sometimes cited to illustrate marten’s tolerance of forest gaps or sparse canopy cover. Ellis described 19-61 percent mature forest at the home range scale. The author offers that the recent shelterwood stands in her study surrounded the smaller old growth stands where marten preferred to rest and den, making it necessary for marten to travel through the shelterwood stands. Further, five female mortalities occurred in or on the edge of (within 10m) shelterwood cuts during her study. Rather than a tolerance, this study may illustrate the predation risk for marten denied forest and/or shrub cover. Similarly, the research in the Lassen area reports 80 percent of marten mortalities were suspected predation events in a region where habitat fragmentation is a concern (Slauson and Moriarty 2011). Kucera (1996) notes that habitat use at the edge of the species range in his study may not represent habitat needs of the core reproductive population. It is worth noting that no animals were found reproducing during his study.

Key winter prey species could be impacted by logging as well. The Douglas and flying tree squirrels are associated with closed-canopy old forest conditions (Slauson and Zeilinski 2008). These species are likely to decline in stands experiencing disturbance from logging or severe fire for 2-10 years (Id).

b) Fire: Potential impacts of wildfire on marten vary. Some research shows high marten use of forests post-fire, where complex physical structures remain on the ground, such as down wood or dense herbaceous vegetation; other studies report minimal use of post-fire forest by marten (Buskirk and Ruggiero 1994). Presumably the impacts of fire on marten would depend upon factors such as the remaining vegetation and structure, and the area affected by severe fire. High elevation red fir and lodgepole pine forests have a relatively low fire return interval, although when it burns the fires can be stand-replacing. Wildfire management plans should identify low severity fire effects as the objective in areas important to marten movement and where movement is otherwise constrained (e.g., narrow areas with low levels of suitable movement habitats.

High intensity prescribed fire has the potential to consume large woody debris on the ground or standing snags that provide important marten habitat. Prescribed fire may increase prey availability temporarily by releasing herbaceous plants from conifer competition, especially in riparian areas overgrown with conifers, and in small grasslands and meadows. The fire effects and benefits from managed fire need to be planned carefully to achieve the desired balance of disturbance to create a varied structure and conservation desirable habitat attributes.

c) Recreation and Urban Expansion: Alpine ski areas are located in marten habitat especially near Lake Tahoe. Several cursory studies investigated the impact of winter and summer recreation activities on marten and reported varied impacts including loss of forest and subnivian habitats, diversion to dumpster food sources, human disturbance from recreation and parking areas, and road mortality (Cablk and Spaulding 2003). Impacts of ski areas are still widely unknown and should be investigated further. Marten may cross open areas under ski lifts and across ski runs during winter (Id). However, whether marten forage in such areas, or merely cross them,
is not clear. According to researchers, “no statements can be made regarding how animals are using the habitat within Heavenly [ski area] without additional snow track data and/or telemetry studies” (I.d., p. 69). Urban expansion poses similar threats to ski areas with habitat loss, road mortality and disturbance.

**Roads:** Road collisions are a source of martens mortality (Buskirk and Ruggerio 1994) including in the Sierra Nevada (Spencer 1981, Martin 1987). There are 12 major highways bisecting martens habitat in the Sierra Nevada at intervals of only about every 30-50 miles. They represent a deadly and ubiquitous threat to martens survival throughout their range.

Roads also introduce novel high elevation species assemblages during winter months where prey is sparse and historically only species adapted for deep snow would tread (i.e., wolverine and martens). Thus, roads facilitate species introductions to high elevations in winter that compete for food and prey upon martens (such as coyotes).

**Cattle Grazing:** Grazing has impacted riparian areas throughout the Sierra Nevada. Martens frequently use riparian habitats in the Sierra Nevada, and grazing is a likely negative impact on this habitat (Spencer et al. 1983, USDA Forest Service 2001). Livestock grazing can also result in the loss of riparian areas through channel widening, channel degradation or lowering of the water table (Kauffman and Krueger 1984, Kattelmann and Embury 1996). National Forest regulations currently exist to protect riparian areas; however, these are inconsistently applied. For example, cattle grazing permittees are now charged with monitoring their own use and reporting back to the agency, furthering the vulnerability of these areas to overuse.

**Rodent Poison:** Poisoning, shooting and trapping of martens is illegal in California, however non-target effects of rodenticide is a potential concern in marijuana plantations (R. Bridgman, Stanislaus National Forest, personal communication, July 2012). Fisher show alarming rates of exposure to rat poison from marijuana plantations in the southern Sierra Nevada (Gabriel et al. 2012). Potential impacts to martens are similar.

**Lack of Information:** Research is needed to clarify seasonal habitat and prey needs of martens in the Sierra Nevada. For example, CWHR models over-predict the availability of marten habitat in the Sierra Nevada (Rustigian-Romsos and Spencer 2010). Thus, agency estimations of forest management impacts on marten habitat are likely underestimated. Genetics information on populations is also urgently needed to gauge the status and demography of Sierran populations.

**Climate Change:** An additional threat to martens is climate change. Because they depend on snow cover in winter, the potential loss of 30-60 percent of snow pack across the species range due to warming trends in the lower-48 states poses a huge risk to the species. The marten in the Sierra Nevada is at the southernmost extent of its North American distribution, and thus is at greatest risk from climate change (Buskirk and Ruggerio 1994, USDA Forest Service 2001). To the extent that Sierra Nevada forests become hotter or drier, climate change would be expected to adversely affect martens by reducing subnivean cover in the winter time, altering winter prey availability and species, restricting movement, and increasing the likelihood of local extirpation. As snow depth decreases, the marten’s need for more coarse woody debris cover increases, emphasizing its importance in forest management activity (Corn and Raphael 1992).

**Desired Condition**

- Sierra Nevada marten populations are stable or increasing.
- Southern Cascade populations are connected to each other and to Sierra Nevada populations.
- Marten travel and dispersal habitat is clearly defined, contiguous and of high quality.
- Marten den and rest sites are protected.

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A Region 5 management plan is in place for monitoring and conservation of marten.
Herbaceous cover in riparian and meadows is adequate to support voles.
Activity that may impact marten such as snowmobile use, ski resorts and busy roads are managed to minimize impact on marten.
Protective measures maintain known or high probability special habitats or sites during project planning and implementation.
Fire in constrained travel corridors is low severity until there are improved opportunities for movement.
Marten are free from exposure to rodenticide and other poisons.

Objectives

- Develop marking prescriptions with support from marten experts that clearly describe how to manage forests while retaining important habitat structure for marten, i.e., high canopy cover, old forest, large woody debris, large snags, ground cover, patches of dense forest, leave islands, contiguous forest cover, quality habitat linkages between watersheds and across landscapes.
- Assess gene flow among and between Sierra Nevada and Cascade marten populations.
- Identify isolated marten populations.
- Enhance habitat connectivity between marten populations.
- Locate marten den and rest sites on each forest within 4 years of forest plan implementation.
- Conduct surveys for marten in the summer (May-November) because summer breeding habitat availability is more limiting.
- Conduct empirical studies on what vegetation types are used by dispersing marten.
- Evaluate, maintain and enhance Sierra Nevada marten habitat connectivity within the Sierra Nevada and the west coast populations.
- Ensure forest management objectives address marten habitat connectivity and movement, especially in the northern Sierra Nevada and Cascades.
- Manage old forest areas for marten denning, resting, hunting and for travel corridors within their range.
- Maintain and enhance key old forest structural elements including large snags, large downed logs and large standing live trees.
- Protect and enhance old forest cover.
- Return degraded Sierra Nevada meadows to more mesic conditions to support vole populations.
- Manage capable Sierra Nevada meadows and grasslands for voles.
- Prevent illegal rodenticide use on National Forests.
- Protect marten habitat from ski area expansion until impacts are better understood.
- Identify roads that pose significant risk to marten and improve passageways and speed enforcement in those areas.

Conservation Measures

- Follow the recommendations for forest management in the conservation strategy, including limits to timber harvest, provisions for over-fisher cover, large wood and large snags, and establishment of den buffers with limited management allowed.
Table A-8. Land allocations specific to Pacific marten conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
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<tbody>
<tr>
<td>Forest Carnivore Den</td>
<td>Den site buffer (700 acres for fisher; 100 acres for marten) designated around known</td>
<td>Limit disturbance during denning (limited operating period).</td>
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<td>Sites</td>
<td>maternal or natal dens.</td>
<td>Retain habitat conditions that support denning.</td>
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<td>Den site buffer (700 acres for fisher; 100 acres for marten) designated around known</td>
<td>Limit vegetation management to reducing surface and ladder fuels to reduce fire risk</td>
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<td>maternal or natal dens.</td>
<td>until new science suggests otherwise.</td>
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<td></td>
<td>Den site buffer (700 acres for fisher; 100 acres for marten) designated around known</td>
<td>Restoration treatments do not remove larger white fir or incense cedar in these areas.</td>
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<td>maternal or natal dens.</td>
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<td>Limit disturbance during denning (limited operating period).</td>
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<td>Limit vegetation management to reducing surface and ladder fuels to reduce fire risk</td>
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<td>until new science suggests otherwise.</td>
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<td>Restoration treatments do not remove larger white fir or incense cedar in these areas.</td>
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<td>Seek input and review from a team of marten experts to evaluate landscape-level and</td>
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<td>stand-level actions using appropriately scaled maps from Spencer and Rustigian-Romsos</td>
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<td>(2012; data also available from Conservation Biology Institute upon request).</td>
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<td>Maintain and enhance marten habitat quality outside the Community Zone (0.25 mile</td>
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<td>buffer around communities and infrastructure).</td>
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<td></td>
<td>Retain all available den and rest structures, including large snags, downed logs in</td>
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<td>decay classes 1 and 2, large standing boles, cavities in large trees, within the</td>
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<td>elevational range for marten and outside the Community Zone (0.25 mile buffer around</td>
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<td>communities and infrastructure).</td>
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<td>Implement marking prescriptions that clearly retain important habitat structure for</td>
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<td>marten per corresponding objective above.</td>
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<td>Retain all available habitat structures, including 60 percent or greater canopy cover,</td>
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<td>multilayered canopy structure, shrub cover, and abundant snags, short stumps and</td>
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<td>large down logs (e.g., greater than 20 logs per acre were found at rest sites (Martin</td>
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<td>(1987)), within the elevational range for marten and outside the Community Zone (0.25</td>
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<td>mile buffer around communities and infrastructure).</td>
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<td>Establish a limited operating period during the denning season (May 1 to July 31)</td>
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<td>within 5 miles of a marten den or rest site.</td>
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<td>Avoid post-disturbance logging in marten habitat.</td>
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<td>Modify hazard tree logging to maintain all marten habitat structures (i.e., fell and</td>
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<td>leave hazard trees) where retaining such material is not a direct threat to human</td>
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<td>safety or property.</td>
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<td>Maintain a vegetation height at 12” or greater in meadows capable of supporting voles.</td>
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<td>Continue to manage roadless areas as roadless and protect new roadless and wilderness</td>
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<td>areas as they are identified.</td>
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<td>Limit over snow vehicle travel within 5 miles of a marten detection.</td>
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<td>Define objectives for use fire in constrained travel corridors to achieve low severity</td>
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<td>fire effects and to avoid stand replacing effects (Spencer and Rustigian-Romsos 2012).</td>
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<td>Form an inter-agency focus group to: 1) Update pesticide labels to restrict over the</td>
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<td>counter use; 2) Investigate the supply chain for rodenticide to marijuana plantations,</td>
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<td>trace sources, and take regulatory actions for distribution pathways.</td>
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<td>Investigate impacts of thinning, forest health, and fuels reduction projects on key</td>
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<td>habitat elements including: canopy cover, bole density, coarse woody debris, potential</td>
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<td>rest sites, home range and landscape composition and fragmentation. Marten response</td>
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<td>variables should include: seasonal habitat use, home range size, and key winter species</td>
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<td>(Slauson and Zielinski 2008).</td>
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<td>Study impacts of ski areas on marten.</td>
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</table>

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Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada for martens. Determine the scale at which heterogeneity benefits martens. For example, evaluate need for patches of multistory stand structure in a treatment unit versus leaving 15-25 percent of units untreated.

References


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**Wolverine (Gulo gulo)**

**Issue Statement**

Wolverines are relatively abundant in Alaska and Canada, and their distribution extends into the contiguous United States from the north-east, Great Lakes region, and northern mid-west. In the western U.S., wolverine were documented from 1801-2005 in the Rocky Mountains of Idaho, Montana and Wyoming, the mountainous regions of Arizona and New Mexico, the Cascade Mountains of Washington, and California’s central and southern Sierra Nevada (Aubry et al. 2007). The highest elevation terrain in the Sierra Nevada, from Yosemite to Sequoia-Kings Canyon National Parks, provides the highest quality wolverine habitat due to its persistent snow cover (USDA Forest Service 2001, Schwartz et al. 2007).

Wolverines live in alpine and arctic habitats and are strongly associated with the presence of deep snow. Wolverines eat small mammals in the summer and scavenge food in the winter. They have wide heads and strong neck muscles to eat frozen bone and drag large carcasses. They persist at extremely low numbers and reproduce very slowly, resulting in populations that are particularly vulnerable to trapping and other human disturbance (e.g., snowmobiles).

**Distribution and Ecology**

*Elevation Range:* Wolverines occur between 2,100-2,600 m (6,800’-8,500’) in arctic, sub-arctic and alpine habitats in North America. Their seasonal elevation range shifts only slightly, with a difference of 99 m (324’) between summer and winter range, presumably due to prey availability (Copeland et al. 2007). Wolverines occur at higher elevations as latitude decreases (Aubry et al. 2007). Consequently, animals in the Sierra Nevada
are expected to reside at the higher end of the species elevation range because they are at the southernmost latitudinal range. Indeed, Joseph Grinnell noted that by 1893 wolverines were restricted in California to high-elevation 2,500–4,000 m (8,200-13,100’) alpine and subalpine habitats in the southern Sierra Nevada (Schwartz et al. 2007).

Habitat: The strongest correlation for wolverine occurrence in the Western US is deep snow that persists until mid-May (Aubry et al. 2007). Vegetative characteristics appear less important to wolverine than physiographic structure of the habitat (Ruggiero et al. 1994). Snow in early spring best explains all wolverine records in the United States ($r^2 = 0.60$) (Aubry et al. 2007). Copeland et al. (2007) found that rock and ice are positively associated with wolverine territories, but suggest that rock is simply a surrogate for elevation, and that there is no direct correlation between rock and wolverines.

Wolverines in the Pacific states occur within or near alpine areas including alpine meadows, barren areas, and montane conifer forests that offer low temperatures and late spring snow cover. Confirmed sightings of wolverine in California were within 1 km of meadows or barren areas (Aubry et al. 2007). Grass and shrub cover was a negative indicator of wolverine presence in Idaho (Copeland et al. 2007).

Moderate overhead cover may be important for resting sites as well as natal and maternal dens. Two radio-telemetry studies found 70 percent of wolverines occurred in montane coniferous forest types with medium to scattered timber (Copeland et al. 2007, Hornocker and Hash 1981). Rest sites in Montana were often in snow with timber cover (Ruggiero et al. 1994). Key conifer species in Idaho include whitebark pine, lodgepole pine and Douglas fir (Copeland et al. 2007). Females and subadults were associated with whitebark pine more than 94 percent of the time in summer. The USDA Forest Service (2001) reports that wolverine are associated with dense forest cover, however no source material is provided.

Reproductive habitat: Two historic natal dens have been reported in California, both were above 10,000’ elevation and near rock shelves (USDA Forest Service 2001). Habitats that provide the appropriate structures, such as large cavities, coarse woody debris, and old beaver lodges, likely will provide den sites (Ruggiero et al. 1994).

Diet: Wolverines are primarily scavengers and rely on other large predators to leave behind bones and fur. They depend on ungulate carcasses throughout the winter. Greater availability of caribou, elk and moose carrion in the northern extent of their range explains increased population size in these areas (Ruggiero et al. 1994). Wolverine may also eat live marmot, snowshoe hare, mink, weasel, marten and other rodents (Id).

Reproduction: Reproductive age for wolverine is estimated at more than three years of age (USDI Fish and Wildlife Service 2008). It may take females two years of foraging to store enough energy to sustain pregnancy and rearing (Id).

Dens are typically used from early February through the spring into May (USDI Fish and Wildlife Service 2008). Natal dens where kits are born are long, complex tunnels in the snow requiring at least 1.5 m (5’) snow depth. In Alaska, they may include features such as logs, boulders, and dry river beds (Aubry et al. 2007). Natal dens in Montana were most commonly associated with snow-covered tree roots, log jams, or rocks and boulders (Ruggiero et al. 1994). Females go to great lengths to find secure den sites, suggesting that predation is a concern (USDI Fish and Wildlife Service 2008). A female may move kits to several different dens over the course of a season, possibly in response to disturbance, predation risk, or deteriorating den condition such as snow melt.
Predators: Wolverine predators include humans, bears, mountain lion, eagles (on wolverine kits), and wolves. Aubry et al. (2007) suggest that wolverine do not occupy elk winter range despite the abundance of prey in order to avoid mountain lion. Breeding season aggression may also be a source of conspecific mortality (Ruggiero et al. 1994).

Home Range: Wolverines occur in low densities, averaging one animal per 150 km\(^2\) (58 mi\(^2\)) (USDI Fish and Wildlife Service 2008). Adult wolverine home ranges in North America can be less than 100 km\(^2\) or as large as 900 km\(^2\) (38 to 560 mi\(^2\)) (Ruggiero et al. 1994, California Department of Fish and Game 2005, USDI Fish and Wildlife Service 2008). The variation in home range sizes among studies may be related to differences in the abundance and distribution of food (Ruggiero et al. 1994). Therefore, individuals at the southern tip of the range, in California, may have the largest home ranges. Wolverine can cover up to 32 km\(^2\) (19.4 mi\(^2\)) a day in Montana, and will travel 10-15 km (6-9 mi) without rest (Ruggiero et al. 1994). Hunting routes can cover up to 2,070 km\(^2\) (800 mi\(^2\)) (California Department of Fish and Game 2005).

In 2009, two remarkable long distance movements were documented as two male wolverine independently dispersed across inhospitable habitat. In March 2009, a male wolverine whose genetics were traced back to the Sawtooth range in Idaho traveled to the Central Sierra Nevada. This individual is likely to have traveled by foot (not aided by humans) because of the remoteness of the Sawtooths and the fact that trapping is not allowed there. The second dispersal event occurred in June 2009 when a radiocollared male traveled over 500 miles from Montana to Colorado. He crossed over 100 miles of sagebrush habitat and Highway 80. These two examples exemplify the extraordinary abilities of this animal and could be associated with climate conditions in 2009 that led to such extreme dispersal events.\(^5\)

Based on these habitat associations, Spencer and Rustigian-Romsos (2012) developed habitat models for wolverine in the Sierra Nevada (Figure A-11).

\(^5\) The Central Sierra Environmental Resource Center has been using remote cameras in a cooperative effort with both the Stanislaus National Forest and Yosemite National Park to assess the presence of rare forest carnivores. A key focus of CSERC’s photo-detection survey efforts is to detect wolverine and Sierra Nevada red fox in areas where previous surveys have not extended into remote areas of suitable habitat. During surveys last year and to date in 2012, CSERC has not detected wolverine, but the Center’s baited camera stations have successfully photographed Sierra Nevada red fox, American marten, and diverse other wildlife at the high elevation cameras, including weasel, bobcat, marmot, deer, bear, snowshoe hare, porcupine, and various rodent and bird species.

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Figure A-11. Potential habitat and movement corridors for wolverine (Spencer and Rustigian-Romsos 2012).
Demography: California wolverines represent a distinct population segment from the other North American wolverine (Schwartz et al. 2007). The genealogical relationship among mDNA sequences indicate that Sierra a split early on in the species North American colonization. There is concern with the low effective population size of wolverine in the lower 48 states (number of individuals contributing to reproduction). The US Rocky Mountains estimated population size is 39 individuals. This is well below the 400 pairs needed for short-term maintenance of genetic diversity (USDI Fish and Wildlife Service 2008).

Threats

Wolverines occur at low densities, making detection and determination of the effects of management activities difficult (Ruggiero et al. 1994, McKelvey et al. 2008).

Population Size/Isolation: Wolverine demography is particularly vulnerable to adult mortality and low immigration rates (Aubry et al. 2007). Wolverines in the continuous US “appear to exist in small, fragmented and semi-isolated populations that put them at greater risk of being lost due to catastrophic or stochastic events than those populations to the north…” (USDI Fish and Wildlife Service 2008, p.12936). Rocky Mountain and Sierran population isolation from Canada is a concern. The Rocky Mountain population may not be sufficient to sustain itself and provide for dispersal into the Pacific Northwest and Sierra Nevada. The small effective population size is contributing to inbreeding and loss of genetic diversity. Genetic diversity is important to maintain resilience to climate change, dispersal obstacles, disease, shifts in prey species, etc. The risk to Sierran wolverine population may be even greater because it has been isolated from other populations for the last 2,000 years (Schwartz et al. 2007). Wolverine in the Sierra Nevada has “the most significantly declining trend and most significantly contracted range and also the highest vulnerability class” compared to any other animal in the Sierra Nevada (USDA Forest Service 2001).

Habitat Fragmentation/Availability: High elevation alpine and sub-alpine wolverine habitat exist as isolated ‘islands’ surrounded by less suitable or non-habitat. Intermountain valleys with human development and roads increase habitat isolation and further diminish potential for dispersal and movement between sub-populations. Climate change poses additional threats to this habitat. “The highly fragmented nature of the habitat in the contiguous US contributes to the low effective populations size for wolverines [in the Rocky Mountain area] …making the continued persistence of the population precarious relative to the Canadian population.” (USDI Fish and Wildlife Service 2008, pg. 12938).

Wolverine are capable of traveling long distances to recolonize habitat, however, female recolonization may be limiting since they usually establish territories adjacent to their natal areas (Ruggiero et al. 1994). Lack of refugia habitat and movement corridors may limit the populations’ ability to persist (Id.). The Forest Service reports that providing adequate quantities of connected forest within the Sierra and between the Sierra and Cascade mountains is critical to the recovery of the species in California (USDA Forest Service 2001). Adequate denning habitat is also called for: “Den sites in forested areas described to date suggest that physical structure may be important for denning. Low availability of natal dens may limit reproduction in some areas, especially those that have been extensively modified by logging or other land-use practices.” (Ruggiero et al. 1994).

Prey Availability: Wolverines have high energetic requirements and live in relatively unproductive areas. As a result, starvation is a concern for the species, especially in areas like the Sierra Nevada where wolves and grizzly bears no longer provide important carcasses for wolverine (Ruggiero et al. 1994). Forest uses that reduce ungulate numbers may reduce an important source of prey availability. Wounding mortality of ungulates from hunting most likely provides a consistent carrion source (Ruggiero et al. 1994). Both deer and marmot are
negatively affected by grazing in California (California Department of Fish and Game 1998, California Department of Fish and Game 2005), and cattle grazing could affect summer wolverine prey availability. Conversely, some argue that livestock grazing provides carcasses for wolverine. However, cows and sheep don’t provide a reliable prey source since permittees go to great lengths to avoid loss of livestock. Migratory mule deer live at high elevations in the Sierra Nevada and provide some carcass for wolverine, at least three seasons per year.

**Human Caused Landscape Alteration:** Grazing, back country skiing and snowmobiling, climate change, forestry, hydroelectric power development, human settlement, and population growth all have affected the productivity and integrity of habitat within wolverine range and warrant careful consideration. Impacts of logging can only be surmised according to Ruggiero et al. 1994):

A preference by wolverines for mature to intermediate forest in Montana (Hornocker and Hash 1981) was not apparent in southwest Yukon (Banci 1987) or in south-central Alaska (Gardner 1985). Hornocker and Hash (1981) reported that although wolverines in Montana occasionally crossed clearcuts, they usually crossed in straight lines and at a running gait, as compared to more leisurely and meandering patterns in forested areas (Ruggiero et al. 1994).

Logging of mixed conifer, lodgepole pine, and red fir habitats in the higher elevations and latitudes of the Sierra Nevada have the potential to disturb or destroy denning sites, prey habitat, or hunting cover for wolverine. Habitat quality and connectivity in the Northern Sierra Nevada connecting the Cascades with higher quality habitat in the Southern Sierra should be evaluated and protected.

An additional threat to wolverine is climate change. Because wolverine are so closely associated with deep snow cover and depend on deep snow for denning, the loss of 3-60 percent of snow pack across the species range warming trends in the lower-48 states poses a huge risk to the species. Climate change may also reduce winter kill of ungulates, thus reducing carrion availability throughout the winter months when food is already scarce.

**Human Disturbance:** Many studies report the potential for human disturbance to wolverine from back country recreation, development and roads (Ruggiero et al. 1994, USDA Forest Service 2001, USDI Fish and Wildlife Service 2008). Wolverine may be pushed into less desirable habitat or may be forced to move den sites to less secure locations due to backcountry recreation activities (Ruggiero et al. 1994). Natal dens are particularly sensitive to disturbance, and in Idaho females with kits have responded negatively to human disturbance (Id.). Copeland et al. (2007) were the only researchers to report a lack of sensitivity to human presence in Idaho, demonstrated by wolverine frequenting active campgrounds, unoccupied hunting lodges, recent snowmobile tracks, and garbage dumps in Canada. They suggest that the negative association of wolverine with people could be an artifact of the remoteness of high elevations where wolverines occur.

**Trapping:** Wolverines are still actively trapped and hunted in Montana, Alaska and Canada. Sadly, wolverine demography in the lower 48 states is highly vulnerable to adult mortality, but averages of 10 adults per year are still killed in Montana. There is great concern among scientists for wolverine population viability in the US Rockies.

The greatest number of wolverines was reported in California in 1921-1930 when 30 wolverines were verified (primarily dead specimens) (USDI Fish and Wildlife Service 2008, Table 1). Two more were killed by Grinell in Yosemite during this time. It was an absolutely dismal decade for California’s top predators, as the last known California grizzly was killed in 1922 and the last California wolf was killed in 1924. This period of zealous...
collection and poisoning of wolverine to protect livestock was followed by a presumed extirpation of wolverine in the state, when only a single animal was confirmed during an 80 year period (USDI Fish and Wildlife Service 2008, McKelvey et al. 2008).

** Desired Condition **

- A management plan for Region 5 is in place for monitoring and conservation of wolverine.
- Sierra Nevada wolverine population is stable or increasing.
- Activities that may impact wolverine, such as snowmobile use, ski resorts and busy roads, are managed to minimize impact on wolverine where recent sightings have occurred.
- Adequate security from motorized access in occupied and dispersal areas is provided in all seasons.
- Secure areas for wolverine are large in size, provide sufficient cover, and are outside the influence of the motorized routes (USDA Forest Service 2006).
- Protective measures maintain known or high probability special habitats or sites (USDA Forest Service 2006).

** Objectives **

- Conduct a wolverine survey to determine the current distribution of the wolverine in the Sierra Nevada (USDA Forest Service 2001).
- Develop a wolverine recovery plan with California Department of Fish and Game (USDA Forest Service 1990).
- Evaluate, maintain and enhance Sierra Nevada wolverine habitat connectivity to other larger populations in the Cascades and Rockies (Magoun 2005). Protect and enhance true fir forest cover, minimize road and OHV route density. Because wolverine populations in the lower 48 states are small and isolated, an assessment landscape features that facilitate or impede immigration is critical for wolverine conservation (Ruggiero et al. 2007).
- Evaluate potential new wilderness and roadless areas for protection.

** Conservation Measures **

- Evaluate the impact and determine appropriate placement of fuels and forest health projects in northern Sierra Nevada on wolverine movement areas linking the Cascades and Central/Southern Sierra Nevada (USDA Forest Service 2001).
- Investigate, evaluate, and monitor sighting reports in coordination with the California Department of Fish and Game (USDA Forest Service 1990).
- If resident animals are discovered, inform and cooperate with California Department of Fish and Game and wildlife researchers to insure the protection of the animals (USDA Forest Service 1990).
- Implement recovery objectives when a plan is completed (USDA Forest Service 1990).
- Protect and enhance true fir forest and special habitat features associated with the species, e. g., talus slopes, boulder fields; beaver lodges; old bear dens; fallen logs; root wads of large, fallen trees; log jams, and large cavities (USDA Forest Service 2010) with in 5 miles of wolverine detection.
- Limit off road and over snow vehicle travel within 5 miles of wolverine detection. High-elevation cirque basins are particularly sensitive during winter and early spring due to association with den sites and should be protected from human disturbance (USDA Forest Service 2006).
- Prohibit new recreation development, and limit helicopter skiing, backcountry skiing and snowmobiling within 5 miles of wolverine detection. Wolverine are sensitive to human recreation activity during winter near den sites (USDA Forest Service 2010).

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- Continue to manage roadless areas as roadless and protect new roadless and wilderness areas as they are identified.

REFERENCES


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BIRDS

This section provides species accounts and conservation recommendations for the following birds (Table A-9).

Table A-9. Native birds with species accounts and conservation recommendations presented in this appendix (California Department of Fish and Game 2011).

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Black -backed woodpecker</td>
<td>MIS</td>
</tr>
<tr>
<td>Strix occidentalis occidentalis</td>
<td>California spotted owl</td>
<td>FSS, MIS</td>
</tr>
<tr>
<td>Strix nebulosa</td>
<td>Great gray owl</td>
<td>CE, FSS</td>
</tr>
<tr>
<td>Accipiter gentilis</td>
<td>Northern goshawk</td>
<td>FSS</td>
</tr>
<tr>
<td>Dryocopus pileatus</td>
<td>Pileated woodpecker</td>
<td>Species of interest</td>
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<tr>
<td>Empidonax traillii</td>
<td>Willow flycatcher</td>
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</tbody>
</table>

Black-backed Woodpecker (*Picoides arcticus*)

Issue Statement

The black-backed woodpecker (*Picoides arcticus*) occurs throughout Alaska, Canada, and the northern United States. They are one of the most specialized birds in the U.S. (Hanson et al. 2012), and they breed primarily in dense coniferous forests, living off of a flush of post-fire insect prey (Dixon and Saab 2000). Although considered uncommon to rare (Ibid), this species plays important ecological roles in western forests by regulating forest beetle outbreaks (Bonnot et al. 2009), and by excavating nest sites for secondary cavity nesters (Saab et al. 2002).

Black-backed woodpeckers are vulnerable to population declines and even extinction because of their genetic isolation and dependence on an ephemeral habitat (Dixon and Saab 2000; Pierson et al. 2010; Hanson et al. March 14, 2013
2012). Oregon populations are considered genetically distinct from the Rocky Mountains. Black-backed woodpeckers are a Forest Service management indicator species in Region 5, a candidate for listing under the California Endangered Species Act, and are also ranked as S3 (vulnerable) in California (NatureServe 2012).

**Distribution and Ecology**

**Elevation Range:** Black-backed woodpeckers live in coniferous forests throughout the Sierra Nevada, generally starting at 3,900 feet in elevation (Bond et al. 2012). An upper elevation range for the species has not clearly been determined in California, and birds may occur more regularly at higher latitudes than in other parts of the country (Siegel et al. 2012).

**Habitat:** Black-backed woodpeckers use burned forests and other large-scale forest die-offs for food and reproduction (Dixon and Saab 2000; Hutto 2008; Hanson and North 2008; Forristal 2009). In burned forest stands, black-backed woodpeckers are consistently associated with high snag densities and dense pre-fire canopy cover (40-90% canopy cover) that result in dense stands of snags after fire (Saab and Dudley 1998; Forristal 2009; Siegel et al. 2010; Hanson et al. 2012). They also live and breed in green forests, but at lesser densities than in burned areas (Bond et al. 2012; Hanson et al. 2012). Green forest habitat is not well defined in California (Bond et al. 2012).

Black-backed woodpeckers respond to food resources rather than any consistent forest structure across their geographic range (Bonnot et al. 2009). They are found in a variety of forest types and conditions including lodgepole pine, fir, mixed conifer, pine and aspen. Dense burned snags are a key habitat element throughout. They may also respond to different habitat attributes at different scales. Bonnot et al. (Ibid) found that nesting black-backed woodpeckers in the Black Hills of South Dakota select for insect food resources in large snags at the territory scale, and for small (10-15” diameter at breast height, or ‘dbh’), dense snags immediately surrounding the nest area.

a) **Foraging habitat:** Black-backed woodpeckers forage almost exclusively on dead or dying trees (Murphy and Lehnhausen 1998; Siegel et al. 2012). They forage on large (20”dbh or greater in the Sierra Nevada) (Bond et al. 2012), conifer snags with intact bark, and intact crowns (Dixon and Saab 2000; Hanson and North 2008; Siegel et al. 2010). In the Sierra Nevada, snag density is an important predictor of occupancy (Hutton and Gallo 2006; Siegel et al. 2011). Foraging is also associated with larger (from 5 acres, but mostly 12 acres and larger) burned forest patches (Saab et al. 2009).

A few recent studies have highlighted differences in habitat preferences among Sierra Nevada birds. Snag density averaged 96ft²/acre and influenced bird occupancy in older (6-10 ys. since fire) burn areas (Saracco et al. 2011). These results indicate a preference by the woodpeckers for a more varied burn severity that extends resource availability through time by providing a steady supply of dying and dead trees for many years rather than a single pulse (Ibid; Bond et al. 2012). An earlier study found black-backed woodpeckers prefer high severity burns, which may be important the first few years following fire (Hanson and North 2009).

In summary, burned, old conifer forests provide important foraging habitat for black-backed woodpeckers (Dixon and Saab 2000; Cahill and Hayes 2008; Hanson and North 2008; Bond et al. 2012; Siegel et al. 2012). Large, dense conifer trees provide important foraging habitat. A portion of black-backed woodpecker populations persist in green forests and habitat requirements in green forest conditions are unknown (Dixon and Saab 2000).
b) **Nesting Habitat:** Black-backed woodpeckers nest in various forest types including ponderosa pine, lodgepole pine, mixed conifer, aspen, Jeffrey pine and Douglas fir in California, Oregon, Idaho and Montana. In several studies, habitat used for nesting also contained (at the 1 km scale): larger diameter trees than surrounding forest, greater snag density, patches of large conifers, and greater pre-fire canopy cover (Forristal 2009; Bond et al. 2012). A synthesis of habitat preferences in California found that black-backed woodpeckers select nest trees between 7”-30” dbh (Bond et al. 2012).

Black-backed woodpeckers excavate nests in dead standing trees averaging 10-15” dbh (Saab and Dudley 1998; Dixon and Saab 2000; Bonnot et al. 2009; Bond et al. 2012). As mentioned above, large diameter snags provide critical foraging substrate for black-backed woodpeckers, but smaller snags are also important as nest trees. Explanations for small nest tree preference include: 1) competition from secondary nesters, 2) nest predation, 3) preference to excavate nests from sapwood, which is more abundant than heartwood in smaller diameter trees (Forristal 2009).

Nest locations are also associated with high snag density (Saab and Dudley 1998; Forristal 2009; Bond et al. 2012). Black-backed woodpeckers used 80-120 snags/acre greater than 10” dbh for nesting in Montana (Hutto 2006) and in Idaho they nested in areas containing upwards of 840 snags/acre greater than 10” dbh (Saab and Dudley 1998). Habitat patch size is another important habitat characteristic for black-backed woodpecker nesting. Nesting probability increases in burned forest of 12 acres or greater (Saab et al. 2002).

Nest densities peak several years (2-5 ys.) following fire (Saab and Dudley 1998; Dixon and Saab 2000; Saab et al. 2007; Bonnot et al. 2009; Siegel et al. 2012). In one study in the Sierra Nevada, black-backed woodpeckers persisted until at least 10 ys post-fire, though at reduced densities (Siegel et al. 2011). Site-specific differences in the timing of peak woodpecker densities may be a function of when heart-rot appears in local trees (Bonnot et al. 2009; Forristal 2009). Alternately, variable fire intensity prolongs snag recruitment, extending local food resources over a longer period of time, and could also extend the presence of black-backed woodpeckers in a burn area (Siegel et al. 2012). Reproductive success can decline along with declining fire intensity (Vierling 2008). This is likely due to the vulnerability of nests to predators, such as tree squirrels, because intense burns displace them immediately following fire. All of these studies support the notion that black-backed woodpecker habitat preferences may change with the age of a burned area, and that it is important to leave a variety of sizes and species of dense snags in order to support black-backed populations.

A recent study in the Sierra Nevada found that nesting black-backed woodpeckers birds use adjacent green forests for foraging (Siegel et al. 2012); however, nesting success of these birds has not been investigated. Nest success may be a key response variable to confirm presumptions about habitat quality because species abundance data is not always correlated with habitat quality, and:

> “Using local abundance or density estimates to make inferences about habitat quality for black-backed woodpeckers is problematic, as they are considered a highly irruptive species and their distribution across the forest landscape is not uniform.” (Forristal 2009)

Birds do nest in poor quality habitat, misidentifying it as high quality, leaving them vulnerable to nest failure. Abundance data alone would not reveal this issue or a potential population sink.

To summarize, black-backed woodpeckers are dependent on forest disturbances such as beetle-kills and wildfires that leave large, dense patches of snags in a variety of sizes from 9” dbh and larger. This is an ephemeral habitat, and land managers should recognize the importance of beetle-kill areas in sustaining populations especially since widespread high intensity fires are so rare (Bonnet et al. 2009).

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**Diet:** Black-backed woodpecker forage almost exclusively by excavating beetle larvae. They appear anatomically adapted for this feeding niche (Dixon and Saab 2000). They show a strong preference for long-horned beetle larvae (Cerambycidae), wood-boring beetle larvae (Buprestidae), and bark beetle larvae (Scolytidae) in the Western U.S. One diet investigation in California documented that white-spotted sawyer beetles (Cerambycidae: *Monochamus scutellatus*) dominated their diet (Murphy and Lehnhausen 1998; Dixon and Saab 2000).

A post-fire peak in black-backed woodpecker abundance, usually observed at two to four years following fire, coincides with the two to three year larval stage of the white-spotted sawyer beetle (Dixon and Saab 2000). These birds may also play a part in regulating forest pest outbreaks following widespread tree die-offs from severe fire (Forristal 2009).

**Reproduction:** Both males and females excavate new nests every year and rear young together (Dixon and Saab 2000; Bond et al. 2012). Nesting initiates relatively early in the season (April-June) possibly because of competition for cavities by secondary cavity nesters (Forristal 2009). Breeding densities are far greater in burned forest, even if home ranges extend outside burn perimeter (Dixon and Saab 2000; Siegel et al. 2012). Preference for breeding in burned areas could be due to nest predator avoidance, or response to increased prey densities in burned areas (Forristal 2009).

**Predators:** Nest predation by Douglas tree squirrels and snakes (most snakes in California are good climbers) (California Herps 2012), and adult predation by a Cooper’s Hawk have been anecdotally recorded (Dixon and Saab 2000). Predation is the primary cause of nest failure in the Rockies (Bonnot et al. 2008; Forristal 2009).

**Home Range:** Home range estimates for black-backed woodpecker vary among different studies. Dixon and Saab (2000) estimates 956a per pair and 178a-306a per individual in burned areas. Siegel et al. (2012) reported that for the Sierra Nevada home range size was 2-3 times larger in unburned than in burned areas. In this study, home ranges in burned forest were in the 400 acre range, similar to those found in central Oregon (from Hanson et al. 2012). Larger home ranges (700+ acres) have been documented in Idaho (Dudley and Saab 2007).

Discrepancies between home range estimates are probably due to several factors, such as the habitat type studied, the time of year (pre or post fledging makes a big difference in home range size), and the different means of calculating home range size. Furthermore, black-backed woodpeckers may retreat to green forests adjacent to old burns (after 6+ years) as beetle activity trails off in the burn and radiates into neighboring green forest (Hutto 2006). Here, home range size could vary depending on the type and quality of habitat used, time since fire, and distance from fire.

**Demography:** Population size has not been calculated for black-backed woodpecker in the U.S. or California, but Bond et al. (2012) summarized research indicating there may be several hundred to several thousand pairs in California. The Breeding Bird Survey does not provide adequate occurrence data to infer population trends for this species (Bond et al. 2012). Research on the species is sparse in California, and there are many unknowns still such as survival rates, population trends, dispersal, winter habitat use, green forest habitat use and degree of dependence on other natural forest disturbances such as beetle-kill events (Bond et al. 2012).

Pierson et al. (2010) identified the west coast (samples from Oregon), Rocky Mountain and Black Hills populations as genetically distinct from each other, possibly warranting separate sub-species distinctions.

**Threats**

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Post-Disturbance Logging: Post-fire logging negatively affects black-backed woodpeckers by removing nesting substrate, feeding substrate, and food resources, thereby affecting adult and nest survival (Saab and Dudley 1998; Morissette et al. 2002; Hutto and Gallo 2006; Saab et al. 2007; Cahall and Hayes 2008; Hanson and North 2008; Bonnet et al. 2009; Forristal 2009; Bond et al. 2012); logging can also create forest structural changes that either make remaining nests more vulnerable to predation, or it can obscure suitable habitat by making moderate or low density “fresh” snags (2-4 ys. old) left after logging to resemble undesirable, well-decomposed snags in a much older burn with sparse snag cover (from Forristal 2009). Even if seemingly adequate densities of snags are left for nesting after partial or less intensive logging, birds can still be negatively impacted by removing food resources (Bonnet et al. 2009), resulting in reduced occupancy and reduced nesting frequency compared to unlogged burned forests (Saab and Dudley 1998; Cahall and Hayes 2009). In a Rocky Mountain study, snag density exceeded the minimum thought to support cavity nesters, but black-backed woodpeckers still nested exclusively in unlogged, burned forests (Hutto and Gallo 2006). In a California study, several black-backed woodpeckers nested in partially logged, burned forest, but nest success was not calculated (Siegel et al. 2011). Clearly, there is a need for snag retention guidelines specifically designed for burned areas, however snag densities required to support black-backed woodpecker occupancy and reproduction have not yet been determined (Bond et al. 2012).

Fire Suppression and Forest Thinning: Logging in green forests to reduce fuel loads may adversely affect black-backed woodpeckers by reducing tree density in subsequently burned forests (Bond et al. 2012). Fire suppression during the 20th century has negatively impacted black-backed woodpecker habitat (Ibid). The dependence of black-backed woodpecker on a variety of dead or dying forest conditions calls into question the validity of fuels reduction as purely forest restoration. Although it might restore or protect some forest characteristics, it is most certainly preventing other natural, ecological processes such as severe fire from occurring. Severe fire can be a disturbance that delivers key food and nesting resources that are otherwise unavailable to black-backed woodpeckers (Hutto 2008).

Nest predation: Nest predation by mostly tree squirrels accounted for 30-100% of nest failure in three studies (from Hanson et al. 2012). It is the leading cause of black-backed woodpecker nest failure in the Rockies (Bonnot et al. 2008; Forristal 2009). As mentioned above, nest success decreases with time elapsed since fire, along with increased nest predation because high intensity fire displaces local predator populations temporarily.

Disease: A fatal nematode infection was documented in a black-backed woodpecker in the Lassen area in California. This particular nematode is found in other woodpecker species and can cause substantial die-offs in other woodpecker species (Siegel et al. 2012). Researchers noted that if it were to spread among black-backed woodpeckers, the nematode “could be a significant factor limiting population growth in this species” (Ibid).

Desired Condition

- Habitat needs of black-backed woodpecker are well understood.
- Black-backed woodpecker populations are stable or increasing.
- Post-disturbance management response includes adequate protection of black-backed woodpecker habitat.
- Natural processes that create black-backed woodpecker habitat are allowed to occur outside urbanized areas.

Objectives

March 14, 2013
- Manage dense forests affected by moderate and severe wildfire for black-backed woodpecker occupancy and reproduction.
- Limit disturbance to black-backed woodpeckers during breeding.
- Manage unburned forest to promote suitable post-fire habitat for black-backed woodpeckers after future fires (Bond et al. 2012).
- Consider benefits of variable intensity prescribed burns during planning to include some severe fire. Use prescribed fire and wildland fire to create primary habitat that is well-dispersed across the landscape (Bond et al. 2012).
- Manage ‘green’ forests in a manner that promotes black-backed woodpecker occupancy (Bond et al. 2012). For example, recruit and maintain black-backed foraging habitat consisting of large (5+ acres), dense stands of dead and dying trees.
- Assume stands that experience mortality due to beetle outbreaks provide black-backed woodpecker habitat (see Goggans et al. 1989; Bonnot et al. 2009).
- Conduct studies on the Sierra Nevada population to determine habitat needs, impacts of logging, thinning, and variable-intensity fires, and genetic isolation on black-backed woodpeckers in the Sierra Nevada.
- Conduct basic demographic research to understand survival and reproduction.

**Conservation Measures**

- In post-fire habitat, retain patches of snags in a variety of decay stages in areas of moderate and high intensity burned conifer forest. These areas can be identified remotely by using moderate to dense pre-fire canopy cover as a surrogate for fire intensity and suitable black-backed woodpecker habitat (Saab et al. 2009).
- Protect important black-backed woodpecker habitat from post-fire logging by retaining patches of dense, burned conifer trees (9”dbh or greater) occurring in contiguous patches of 5 acres or greater. Also retain the highest densities of the largest trees to support foraging (Bond et al. 2012), except where human life and property are at risk.
- Retain all trees with active black-backed woodpecker nests.
- Avoid post-fire logging in black-backed habitat for 5 - 8 yrs. (Dixon et al. 2000), if at all.
- Retain dense patches of pine snags within 300 feet of wildfires and wood-boring beetle outbreaks (Bonnet et al. 2009; Bond et al. 2012).
- Limit mechanical operations near or in potential habitat* between May 1- August 1 (Bond et al. 2012).
- Consider implementing prescribed fire in the unburned periphery of recent fire areas 5 to 6 years after fire to create additional black-backed woodpecker habitat as the habitat suitability of the original fire area begins to wane.
- Use prescribed fire, especially with mixed-severity effects, to create black-backed woodpecker habitat that is well-distributed across the landscape, especially in areas that have not experienced wildfire recently. Note that some degree of tree mortality resulting from prescribed burns is likely to be beneficial to black-backed woodpeckers (Bond et al. 2012).

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6 Burned forest habitat for black-backed woodpecker is summarized in the habitat section above as containing:
- burned conifer forest of 12 acres or greater
- dense conifer snags (average of 96ft²/acre, or 80-800 snags/acre > 9” dbh)
- 40-100% pre-fire canopy closure
- variable or high fire intensity
- within 1-10 years post-fire (see habitat section above for references).
• Allow naturally ignited fires to burn and create optimal black-backed woodpecker habitat in forested areas outside the wildland-urban interface (WUI) (Bond et al. 2012).
• Manage unburned forest to promote recruitment of large trees and patches of high tree density to improve habitat quality after fire occurs.
• Retain snags and dense patches of conifers in green forests during forest thinning to allow tree mortality and support black-backed woodpecker population persistence between wildfire events (Bond et al. 2012). In areas with aggregations of recent (<8 years) beetle-killed trees managed for black-backed woodpeckers, avoid harvesting snags (Bond et al. 2012).
• Conduct logging aimed at tree mortality prevention only near homes.
• Avoid cutting standing snags for fuelwood in recent fire areas (<8 years postfire) during the nesting season (generally May 1 through July 31). Harvesting of a portion of the available downed trees is an alternative that will not jeopardize black-backed woodpecker nests (Bond et al. 2012).

References


http://www.californiaherps.com/behavior/snakebehavior.html


Hanson, C.T., Coulter, K., Augustine, J. and Short, D. 2012. Petition to list the black-backed woodpecker (Picoides arcticus) as threatened or endangered under the Federal endangered species act. May 2, 2012. 115 pgs.


March 14, 2013

**California Spotted Owl** (*Strix occidentalis occidentalis*)

**Issue Statement**

California Spotted Owl is a long-lived and highly territorial species found in the mixed-conifer and oak woodland forests of the western Sierra Nevada and the southern coast range of California. California Spotted Owl is considered a species of special concern in the state of California, but unlike the northern and Mexican subspecies, is not federally listed. Studies on habitat use and life requirements of the California spotted owl universally concluded that it is a habitat specialist, which selects stand characteristics associated with old growth or mature forests for nesting, roosting, and foraging.

NatureServe lists the population as declining 10-30 percent in the short-term, and 25-50 percent in the long term:

“A study of population dynamics of California spotted owls from four locations in the Sierra Nevada and one location in southern California (San Bernardino Mountains), spanning the years 1986-2000 overall, found suggestive but not conclusive evidence of an overall population decline (Franklin et al. 2004).

“Demographic data collected in and around Lassen National Forest in northeastern California indicated an annual rate of decline in the territorial population of 9 percent per year over the period of study (1990-1999) (Blakesley et al. 2001). (NatureServe 2011)

The population of owls has been monitored on four study areas in the Sierra Nevada over the last 20 years. The results of the three demographic studies on national forests in the Sierra Nevada confirm the existence of a decline in the population over the last 20 years (Keane et al. 2011, Guitierrez et al. 2012, Keane 2012, Munton et al. 2012, Scherer et al. 2012). Results from the single study in the Sierra Nevada on national park land indicate that the population is stable to increasing (Id.). Sierra Forest Legacy joined several other environmental groups in submitting a petition for federal listing of the sub-species under the ESA with the U.S. Fish and Wildlife Service on September 1, 2004. On May 23, 2006, the U.S. Fish and Wildlife Service (USFWS) announced that listing the species was not warranted. Citing unpublished data provided by the U.S. Forest Service, the USFWS concluded that wildfire posed a far greater risk to spotted owl populations than did the current timber harvest standards on public and private land in California. At that time, the USFWS found that “the best available data indicate that survival of spotted owl populations in the balance of the State of California (the Sierras) has been improving at the population level…We expect this trend to continue as the Forest Service in the Sierras implements its fuels reduction strategy that includes protections for the spotted owl and its habitat” (Federal Register, Vol. 71, No. 100, p. 29901). Contrary to this finding, populations have declined in three study areas within the Sierra Nevada during the time that the Forest Service has been implementing its fuels reduction strategy; there has not been an improvement at the population level. Further, the population in the San Bernardino area essentially has been extirpated. The status and trends for spotted owl are significantly worse today than when the listing determination was made in 2006.

**Distribution and Ecology**

**Nesting Habitat**

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Spotted owls nest primarily in Sierran mixed conifer forests (Verner et al. 1992a). They use platform structures such as broken tops of trees or cavities and occasionally will use brooms on branches or old nests left by other species (Id). Between 20-30 percent of spotted owls in the Sierra Nevada nest in oaks occurring in mixed conifer, oak woodland and riparian areas (Gutiérrez et al. 1992, LaHaye et al. 1997).

The US Forest Service EIS for the 2001 SNFPA cites six studies, most of which are found in Verner’s 1992 technical report which summarize spotted owl nesting habitat preferences as follows:

- two or more canopy layers
- dominant and co-dominant trees in the canopy averaging at least 24” dbh
- higher than average numbers of very large, old, trees with high crown volume
- higher than average levels of snags and downed woody material

The research cited above indicates that dense canopy cover and large, old conifers and oaks are key components in spotted owl nesting and roosting habitat. On the Lassen NF, nest stands contained large trees (more than 24” dbh); these areas were selected more frequently for nesting relative to their abundance in the areas. Stands dominated by medium sized trees (11-24” dbh) were used with disproportionately low frequency compared to their availability (Blakesley et al. 2005, pg.1559). Keane (2008) reported 53 percent of nest sites were located in CWHR 5M, 5D and 6 habitat, indicating a preference for large trees and moderate to dense canopy.

Canopy cover in nest stands averaged more than 70 percent in most studies, again pointing toward an association with dense, mature conifer stands. Blakesley et al. (2005) reports that canopy cover at nest sites is “virtually always more than 80 percent (pg. 1560). Keane (2008) reported an average of 64 percent canopy cover. The difference in canopy cover at nest sites might indicate a range of preferences by owls, or may indicate differences in techniques used to measure canopy cover. Nonetheless, both measurements are consistently high. Roosting habitat is similar to nesting habitat, typically consisting of 70-75 percent canopy cover (Bias and Gutiérrez 1992, Verner et al. 1992b).

Spotted owl nest sites also contain elevated levels of snags and downed wood. Steger et al. (1997a) reported 12 large snags per acre at nest sites in the Southern Sierra. The 2007 Plumas Lassen Administrative Study reported that coniferous nest sites were characterized by 7.4 snags per acre. Snag density averaged 153.5 m3/ha in another Southern Sierra study (North et al. 2001). Current USFS snag retention guidelines of 4 snags per acre appear inadequate because they do not protect the average number of snags in nest stands.

Nest tree sizes vary somewhat, but mostly belong to the largest size classes across the Sierra. Nest trees in the Sierra Nevada averaged 45” dbh (Blakesley 2003, Steger et al. 2997). Riparian/ hardwood nest trees are usually smaller than conifers on average at 29” (Gutiérrez et al.1992). Approximately 90 percent of nest trees on the Lassen National Forest were more than 30” dbh (Blakesley et al. 2005).

Understory forest structure may be important to spotted owl breeding habitat as well. Research on the Eldorado National Forest found that 35 percent of the basal area of all trees at nest sites (110 ft.2/a out of 309 ft. 2/a) was in size classes 20” dbh and smaller (Verner et al. 1992a).
Table A-10. California spotted owl nesting habitat associations. (n/r = not reported)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Canopy Cover</th>
<th>CWHR Type</th>
<th>Snag Density</th>
<th>Downed Wood</th>
<th>Basal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias &amp; Gutiérrez 1992</td>
<td>89%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Gutiérrez et al. 1992</td>
<td>40-100%</td>
<td>45% nest stands in M5M, M5D</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Verner et al. 1992a (p.91) Nest Stand Records</td>
<td>75% in conifer stands</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
<td></td>
</tr>
<tr>
<td>Verner et al. 1992a</td>
<td>70% mixed conifer</td>
<td>n/r</td>
<td>30-55 ft²/a</td>
<td>10-15 tons/a</td>
<td>185-350 ft²/a</td>
</tr>
<tr>
<td>Steger et al. 1997</td>
<td>90%</td>
<td>n/r</td>
<td>24/a</td>
<td>n/r</td>
<td>67-75 m²/ha</td>
</tr>
<tr>
<td>North et al. 2000</td>
<td>76%</td>
<td>n/r</td>
<td>153 m²/ha</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Bond et al. 2004</td>
<td>77%</td>
<td>M4M, M4D, M5M, M5D</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Blakesley et al. 2005</td>
<td>&gt;70%</td>
<td>&gt; 4M</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Chatfield 2005</td>
<td>30%-70%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Seamans 2005</td>
<td>70%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Keane 2008</td>
<td>64%</td>
<td>4M, 4D, 5M, 5D, 6</td>
<td>7.4/a</td>
<td>260 ft²/a</td>
<td></td>
</tr>
</tbody>
</table>

Foraging Habitat

Less information exists as to the foraging habitat preferences of spotted owls. Foraging habitat is more difficult to characterize than breeding habitat for several reasons. First, the habitat appears more variable. Second, when owls are away from the nest, it is more difficult to distinguish foraging versus other behavior. Nonetheless, spotted owls are still associated with older forests in foraging studies. Stands preferred by owls for foraging have (USFS 2001):

- at least two canopy layers
- dominant and co-dominant trees in the canopy averaging at least 11” dbh
- at least 50-90 percent canopy cover
- higher than average levels of snags and downed woody material

The average home range size for spotted owl in the Sierra Nevada is 4,200 acres and includes wintering as well as breeding habitat (Zabel et al. 1992). Home range may vary by latitude and elevation. Average home ranges on the Sierra National Forest in the Southern Sierra were approximately 2,500 acres (Verner et al. 1992a). Breeding territories were delineated in the northern Sierra at 2,000 acres (Blakesley 2005), in the central sierra at 988 acres (Seamans 2005) and 1,168 acres (Chatfield 2005). The USFS protects breeding home range areas of different sizes according to their location in the Sierra. In the northeastern Sierra, Home Range Core Areas (HRCAs) are 2,400a. The northern and central Sierra forests set aside 1,000 acres for each PAC. In the Southern Sierra, HRCAs are 600 acres. The breeding core area is about 20 percent of the home range (2001, V.3, Ch.3, pt.4.4, pg.75).

The primary prey species for spotted owl in mid to high elevations in the Sierra Nevada above 4,000-5,000 feet are flying squirrels (Verner et al. 1992a). Spotted owl diet on the Lassen National Forest is comprised of 61 percent flying squirrel. Southern Sierra owl diets were also 61 percent northern flying squirrel (North et al. 2000). Woodrat are also an important prey species at mid- and lower elevations, providing more of spotted owl.
energy requirements than flying squirrel (Verner et al. 1992a). Oak woodland owl diet is 80 percent woodrat and these owl territories are smaller and closer together, perhaps because of prey availability (North et al. 2000).

Table A-11. California spotted owl foraging habitat associations. (n/r = not reported)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Canopy Cover</th>
<th>Snag Density</th>
<th>Downed Wood</th>
<th>Basal Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call et al. 1992</td>
<td>&gt;40%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Gutiérrez et al. 1992</td>
<td>50-90%</td>
<td>15-30 ft²/a</td>
<td>10-15 tons/a</td>
<td>180-220 ft²/a</td>
</tr>
<tr>
<td>Zabel et al. 1992</td>
<td>&gt;40%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Blakesley et al. 2005</td>
<td>&gt;40%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Chatfield 2005</td>
<td>&gt;70%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
<tr>
<td>Gallagher et al. 2008</td>
<td>50-60%</td>
<td>n/r</td>
<td>n/r</td>
<td>n/r</td>
</tr>
</tbody>
</table>

**Threats**

Risk factors to spotted owl distribution and abundance include habitat loss, stand replacing wildfire, disease, climate change, drought, barred owl invasions, nesting survival, residential development, recreation, and disturbance (Verner et al. 1992a, Blakesley et al. 1999, Franklin et al. 2000, USDA Forest Service 2001, Anthony 2004).

**a) Habitat Loss:** Extensive loss of habitat has occurred throughout the spotted owl’s Sierra Nevada range (Verner et al. 1992a). Logging since the turn of the century has resulted in a reduction in the amount and distribution of mature and older forests and specific habitat elements such as large trees, snags, and downed logs used for nesting and foraging by spotted owls (Verner et al. 1992a, Laudenslayer 1990, McKelvey and Johnston 1992). Much of the current concern regarding the sub-species population trends is focused on the effects of vegetation management on the distribution, abundance and quality of habitat.

Habitat loss has been linked to decreased reproductive output, decreased adult survival and an increase in territory abandonment. Seamans (2005) associated habitat loss with decreased survival. Another study by Blakesley et al. (2005) also showed a positive relationship between site occupancy, survival probability, reproductive output and nest success with presence of quality nesting habitat.

Even relatively small scale habitat loss in spotted owl territories is linked to owl emigration and decreased territory colonization. Verner et al. (1992a) and Moen and Gutiérrez (1992) found that spotted owls are sensitive to relatively small scale stand alteration within breeding territories. Further, Seamans and Gutierrez (2007) found that alteration of more than 49 acres of mature conifer forest within individual territories was negatively related to territory colonization and positively related to the probability of breeding dispersal. In other words, if pockets of dense canopy cover and large trees aren’t retained where they occur in territories, the owls are more likely to leave.

Forest Service projects consistently reduce habitat quality to the least amount of canopy cover (40 percent) considered by some as suitable for the owl (USFWS 2006). This leaves spotted owl habitat in a condition for foraging that is not favored by owls (Keane 2008).

**b) Habitat Fragmentation:** This is of concern on the Lassen NF, Tahoe NF, Eldorado NF and Stanislaus NF because there are large inclusions of non-federal lands, including Sierra Pacific Industries, that pose March 14, 2013
uncertainty associated with maintaining intact nesting habitat and a well-distributed spotted owl population and (Verner 1992a, USDA Forest Service 2001).

c) **Wildfire:** High-severity wildfire has been identified as a threat to spotted owl habitat. Large stand replacing events can significantly alter habitat conditions. Resident birds have been known to leave severely burned landscapes; however, since these areas were also salvaged logged it is difficult to determine the specific cause for post-fire movements (Keane 2010). The USFWS identified wildfire as the most significant threat to spotted owl in the Sierra Nevada (USFWS 2006). The 12-month finding reports varying impacts of wildfire on spotted owl habitat. The agency assumed fires generally have a negative impact on owl habitat (Ibid) and concluded that they consider risk from catastrophic fire to be a far greater concern than any other threat evaluated (Ibid).

Several studies have identified the use of burned landscapes by nesting and foraging owls. Based on data from all three spotted owl subspecies, Bond et al. (2002) hypothesized that non-catastrophic "wildfires may have little short-term impact on survival, site fidelity, mate fidelity, and reproductive success of spotted owls. Further, prescribed burning could be an effective tool in restoring habitat to natural conditions with minimal short-term impact on resident spotted owls." Bond et al. (2009) used radio telemetry to assess owl use patterns in a burned landscape that was not salvaged logged. This study found higher than expected owl foraging in high-severity burn areas. Roberts et al. (2011) found owls use forests that burned at all severities and concluded that "low to moderate severity fires, historically common within montane forests of the Sierra Nevada, California, maintain habitat characteristics essential for spotted owl site occupancy." These studies indicate that wildfire as a general matter does not adversely impact owl habitat use of occupancy and in some cases owl use of post-fire landscapes may be enhanced.

d) **Nestling Survival:** Late winter and early spring storms threaten spotted owl nesting success (Seamans 2005, Franklin et al. 2000, North et al. 2000, Forest Service 2001). Alteration of canopy cover can remove important thermal cover and shelter from elements vital to juvenile survival (North et al. 2000).

e) **Breeding Habitat Disturbance:** Disturbance from recreation activities may interfere with owl nesting success.

f) **Barred Owl:** This species has been shown to out-compete spotted owls for nesting habitat in Washington and Oregon (Anthony et al. 2004). The ongoing decline of Northern spotted owl on the California coast was hypothesized to be largely a result of barred owl expansion into Northern spotted owl range over the past 15 years. The species is experiencing a rapid range expansion in the Sierra Nevada. There have been 41 detections on barred owl on the Plumas and Lassen NF (Keane 2008). Barred owls and sparred owls (barred-spotted hybrid) have also been detected on the Lassen, Plumas, Eldorado, Stanislaus and Sequoia National Forest to the south (personal communication, J. Keane).

g) **Disease:** The effect of West Nile virus on owl populations is uncertain at this time because the disease was only recently detected in the Sierra Nevada (summer 2005). It is expected to have a 100 percent mortality rate in infected spotted owls (J. Keane, personal communication. June, 2004).

h) **Prey:** Species reductions from impacts to duff and topsoil layers, snag density, reduction in large, old trees (Verner et al. 1992a).

The California spotted owl range encompasses part of California and possibly northern Baja California, from southeastern Shasta County south through the Sierra Nevada to Kern County; Coast/Peninsular Ranges from March 14, 2013
Monterey County to San Diego County; possibly the Sierra San Pedro Martir in northern Baja California. The USFWS estimated there were 1,400 territories in the Sierra Nevada on public land (USFWS 2006).

Spotted owls are characterized as late-seral stage closed canopy forest specialists (Bias and Gutiérrez 1992, Gutiérrez et al. 1992, Seamans 2005). They are associated with complex forest structure including greater canopy cover, basal area, snag density, and presence of large (more than 35.4”) trees compared to average Sierran forest conditions (Gutiérrez et al.1995). They occur between 1,000’ to 7,700’ in the Sierra Nevada, and at higher elevation at the southern end of their range (Verner et al. 1992b). Most (86 percent) spotted owls nest between 3,000’-7,000’ (Id).

**Desired Condition**

- Population trends throughout the Sierra Nevada are stable or increasing.
- Territories contain high quality habitat described in Table 1 and 2 with large, multi-storied trees, dense canopy cover, and sufficient downed wood and snags.
- Occupied habitat is managed 1) to support successful reproduction and survival; 2) to maximize suitability at multiple scales; and 3) for desired old forest conditions in the short and long term.

**Objectives**

- Maintain and enhance existing spotted owl habitat.
- Manage fuels and stand density in occupied habitat without compromising mid-sized and large trees in stand.
- Design vegetation management to retain and enhance habitat elements that characterize high quality nesting and foraging habitat.
- Vegetation management and other activities maintain owl occupancy

**Conservation Measures**

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, provisions for understory vegetation, large wood and large snags, and establishment of protected activity centers (PACs) and home range core areas (HRCAs).

Table A-12. Land allocations specific to California spotted owl conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected Activity Center (PACs)</td>
<td>Designation around known nesting sites for California spotted owl (300 acres) and great gray owl (50-200 acres). Inclusion in PAC of area within 300 feet of structures is avoided.</td>
<td>Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy</td>
</tr>
<tr>
<td>Home Range Core Area (HRCA)</td>
<td>Area around California spotted owl nest site and including the PAC. Size ranges from 600 acres to 2,400 acres depending on location in the Sierra Nevada.</td>
<td>Provide for high quality foraging habitat near to nest stands. Manage for low risk of loss of occupancy</td>
</tr>
</tbody>
</table>

- Use managed fire to the maximum extent possible to create variability in forest structure.
Management of Occupied Spotted Owl Habitat (PACs and HRCAs)

- In the Community Zone, the first priority is to meet fuels objectives to protect public health and safety followed by meeting spotted owl habitat objectives. Removal of trees larger than 16”-20” dbh can rarely be justified for fuels reasons (North et al. 2009).

- Outside the Community Zone (0.25 mile buffer around communities and infrastructure), spotted owl management in PACs and HRCAs is the first priority. Other objectives are only appropriate when it can be demonstrated in an the restoration plan that spotted owl objectives for maintaining and enhancing suitable habitat can be met. Removal of trees larger than 16”-20” dbh can rarely be justified for fuels reasons (North et al. 2009).

- Retain suitable structures for nesting such as large trees with broken tops, cavities, platforms and other formations (North et al. 2009).

- Retain all snags in PACs and HRCAs except to address imminent hazards to human safety (Id., p. 22; USFS 2001). Retain 8 snags/ acre >15”dbh, or a minimum of 20 ft²/acre outside PACs (Verner et al. 1992b, Pg. 22). When snags need to be removed for human safety, cut and leave snags in place on ground. Consider topping snags with >15’ sound trunk; leave top and trunk on site. Consider flagging off avoidance areas where hazardous snags occur in units to protect worker safety and retain snags.

- Maintain existing breeding habitat (i.e. >70 percent canopy cover) key to spotted owl survival. Design treatments to maintain average canopy cover for spotted owl territories, not minimal thresholds for survival. Land managers in the SN region should retain forest stands dominated by large trees with canopy cover >70 percent and minimize the amount of area unsuitable to California spotted owl within [494 acres] 200 ha surrounding spotted owl site centers to promote site occupancy and increase California spotted owl reproductive output. Results from Blakelsey et al. (2005) suggest that within owl core areas (814ha) increases in the availability of habitat used by California spotted owl for nesting, roosting and foraging will increase owl survival.

- Manage spotted owl habitat at multiple scales:
  - At the watershed scale, minimize gaps in spotted owl distribution by avoiding treating adjacent PACs in the Community Zone as a means to limit con-specific attraction and allow recolonization of suitable habitat. Maintain habitat connectivity between territories and watersheds. Old Forest-Connectivity (OFC) areas should be managed to maintain connectivity between owl territories at this scale.
  - At territory scale, minimize fragmentation of habitat and maintain or enhance high quality habitat (see Tables A-1- and A-11).
  - At stand scale, maintain multi-story habitat around roost and nest locations and promote key stand structure throughout including clumps of large trees, multi-layered canopy, nest platform sites, large snags, and downed wood.

- Conduct vegetation treatments in no more than 10 percent of the total number of owl PACs per decade. Track PAC entry for vegetation management annually by watershed. Include in the calculation of “treatment” any activity where suitable habitat is removed: severe wildfire, severe managed fire, mechanical activity, etc.
- Focus thinning on firs and cedars. Avoid thinning pines except in plantations. Avoid thinning hardwoods (North et al. 2009).

- Prohibit mechanical treatments within a 500-foot radius buffer around PAC activity centers (modified from USFS 2001).

- Maintain a limited operating period (LOP) from March 1- August 15 prohibiting activities within approximately ¼ mile of the PAC boundary during the breeding season unless surveys confirm that spotted owls are not nesting. The LOP can be reduced to ¼ mile from the active nest site, if known. The LOP applies to all mechanical activities, including road repair, motorized recreational events, increased haul truck traffic on roads, etc. unless a biological evaluation documents that such projects are unlikely to result in breeding disturbance. Considering intensity, duration, timing and specific location. Where a biological evaluation determines the nest site will be shielded from planned activities by topographic features that minimize disturbance, the LOP buffer may be reduced (modified from USFS 2001). The LOP may be waived to allow for early season prescribed burning in up to 5 percent of the PACs on a national forest per year.

Management of Suitable Unoccupied Spotted Owl Habitat (CWHR 4M, 4D, 5M, 5D & 6 stands)

- Only remove intermediate sized trees 20-30” dbh when they are shade-tolerant and on mid or upper slopes (North et al. 2009) when high quality owl habitat can still be protected.

- Assess habitat value of CWHR 4M and 4D habitat with a site specific analysis that is supported by stand exam data as part of environmental review for each project. Avoid treating CWHR 5M and 5D for reasons other than to meet Community Zone fuels objectives or to allow managed fire.

- Retain suitable structures for nesting such as large trees with broken tops, cavities, platforms and other formations (North et al. 2009).

- Apply stand structure concepts described in the structural diversity section of this conservation strategy.

- Conduct surveys in compliance with the Pacific Southwest Region’s survey protocols during the planning process when proposed vegetation treatments are likely to reduce habitat quality in suitable California spotted owl habitat with unknown occupancy. Designate California spotted owl protected activity centers (PACs) where appropriate based on survey results (USDA Forest Service 2004).

Other Recommendations

- Continue the owl demographic studies until the results from the habitat analysis are completed and a proposal for future monitoring has been endorsed by owl scientists and adopted by Region 5 of the Forest Service.

- Assess the impact of applying North et al. (2009) to forest management in the Sierra Nevada for spotted owls (North et al. 2009). Determine the scale at which heterogeneity benefits spotted owls. For example, evaluate need for ¼-1 acre patches of multistory stand structure in a treatment unit vs. leaving 15-25 percent of units untreated, as specified in the 2001 Forest Plan Amendment. Summarize and apply all relevant spotted owl research conducted since the interim guidelines for California Spotted Owl management was released in 1993.

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• Issue regional guidance for analyzing vegetation management impacts to spotted owls and their habitat at multiple scales (i.e. 300 acre PAC, 500 acre nest core, and 1,000 acre HRCA).


• Monitor barred owl invasion in the Sierra Nevada. Evaluate options for protecting spotted owls in the Sierra Nevada based on extent of invasion and outcome of experimental removal done by Oregon Fish and Wildlife. If aggressive action is proposed, it should be implemented as soon as possible.

• Determine long term impacts or benefits of the range of wildfire effects and post-fire management on spotted owls (Bond et al. 2009).

• Determine how forest structure and composition varied by topographic feature under an active fire regime in the Sierra Nevada (North et al. 2009).

References


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USDI Fish and Wildlife Service 2006. 12-month finding for a petition to list the California Spotted Owl (*Strix occidentalis occidentalis*) as Threatened or Endangered. 71 Federal Register (no. 100) 29886-29908. (May 24, 2006).


**Great Gray Owl (Strix nebulosa)**

**Issue Statement**

The California great gray owl population is estimated at only 100-200 individuals (Winter 1980, Hull et al. 2009, Keane 2010), raising concern over long-term population survival. Hull et al. (2009) estimated California’s effective population size to be 14 breeding individuals, indicating a significant and recent population bottleneck (Id). At such low numbers, the population is vulnerable to inbreeding as well as stochastic events such as disease, uncharacteristic wildfire, and unmonitored grazing prevalent in breeding territories on Forest Service land (Hull et al. 2009). The Forest Service PSW research station recently began a demography study on the Yosemite population.

**Distribution and Ecology**
The breeding range of great gray owls in the United States includes portions of Alaska, the Cascades, Sierra Nevada and Rocky Mountains, as well as portions of Minnesota, Michigan, Wisconsin, and New York (Verner 1994). Although primarily a boreal species, California’s great gray owl population, which is centered in Yosemite National Park and is entirely located in the Sierra Nevada Mountains, is the southernmost population in the U.S. The Sierra Nevada population has been determined to be a separate subspecies, genetically distinct from the Cascades and other populations (Hull et al. 2010).

Sierra Nevada great gray owls are generally associated with dense mixed conifer, red fir, or lodgepole pine forests, and adjacent montane meadows from approximately 2,500 to 9,000 feet in elevation (Greene 1995). Winter downslope movement occurs between November and April to an average of 4,000 feet in elevation (range was 2,300-5,500 feet) (Jepsen 2009). Great gray owls prefer to forage in open areas, such as open forest and meadows, and use the scattered trees of the forest margin to perch and search for prey. They have also been observed foraging in clear-cuts and plantations, although prey density is generally lower in these areas (Greene 1995). Burned areas are thought to provide early-seral 'meadow surrogate' habitat with high rodent densities. New owl territories can be established within 5-10 years following a large fire (Roy Bridgman, personal communication).

The great gray owl’s primary food source is meadow-dwelling rodents, especially pocket gophers and voles, but it will occasionally eat birds (Johnsgard 2002, CDFG 2010). Although gophers are more abundant in meadows of the Sierra, their fossorial (underground) habit may limit their value as prey for owls (Greene 1995, Winter 1986). Gophers may be sufficient to maintain non-breeding individuals when the more cyclical vole populations are low in numbers, but vole abundance and suitable habitat correlates are among the best predictors of great gray owl presence and reproduction (Id).

In the Sierra Nevada, great gray owls nest in broken-top trees and cavities near meadows (Bull and Henjum 1990, Winter 2005). Great gray owls require mid to late succession forest to nest (Bull et al. 1988). Nest trees are typically greater than 24 inches diameter at breast height (dbh), and nest height can range from 25 to 72 feet (CDFG 2010). This species sometimes use nests built by other raptors, particularly goshawks, and will also use artificially constructed platforms (Bull and Henjum 1990). Canopy cover in nest stands ranges from 65-100 percent and provides protection from potential predators such as great horned owls and goshawks and for thermal cover from the sun, an important factor for this boreal species at the southernmost extent of its range (Beck and Craig 1991). Removal of over 50 percent of forest cover may eliminate great gray production (Id). This may be because goshawks are also eliminated from the area and are no longer able to provide nest structures, or because lower canopy cover makes owls vulnerable to inclement weather during nesting and to predation.

Breeding in the Sierra Nevada begins in late February with the peak of egg-laying in mid-April through late May. Incubation takes 28-29 days (Johnsgard 2002) with fledging after a minimum of 21-28 days (CDFG 2010). The young remain in the nest area until they are four to five months old (Johnsgard 2002). Fledged owls do not fly immediately, and spend a lot of time on the ground, where dense vegetative cover and leaning trees for climbing are important (Beck 2005, Winter 2005).

Based on the studies in California, breeding home ranges average between 0.16-1.75 mi² and most of the owl's time is spent in the 600-foot forested buffer zone (Winter 1986, Sears 2006, Stermer 2010). Owl activity is concentrated within 900 feet of the meadow and forest-edge habitat during breeding (Winter 1982). He also found 90 percent of activity within 800 feet of meadow edge, and Greene (1995) similarly found owl nests within 880 feet of meadow edge. Persistently occupied meadows in the Sierra Nevada are typically over 25-30 acres in size and offer high quality meadow vegetation throughout the breeding season (Winter 1982, Winter 1986).
1986, Greene 1995, Hayward and Verner 1994); however, many owls nest along meadow complexes that are much larger, i.e., 100-400 acres, possibly because of lower quality of meadow vegetation and associated prey.

Numerous studies have documented predation on great gray owls. Northern goshawks and great horned owls frequently prey on juvenile great gray owls (Duncan 1987). Bull and Henjum (1990) also report many juveniles are killed by avian predators. High canopy cover and multi-story canopy near the nest is thought to reduce predation risk.

Beck and Winter (2000) recommend maintaining a minimum of 6 snags/acre, 70-100 percent canopy cover, and 5-10 inches of residual meadow cover in protected activity centers (PACs), i.e., the 50-acre area surrounding a nest site. Dead and downed wood should be left for cover for voles. Burning that destroys this downed material should be avoided (Bull and Henjum 1990).

**Threats**

Habitat degradation is a management concern for the great gray owl. The loss of large trees needed for nesting, the effects of conifer encroachment, and overgrazing to meadows have likely reduced the population from historical numbers (Winter 1986, Hayward and Verner 1994). Three quarters of nests in one Oregon study occurred in unlogged stands (possibly because of large tree availability) (Bull et al. 1988). Urbanization in the owl’s winter range is another source of habitat loss in California. Approximately 48 percent of the owl’s wintering habitat area is in private ownership, with 35 percent on U.S. Forest Service lands, and 14 percent on National Park lands (Jepsen 2009). Development trends show that by 2040, 60 percent of wintering habitat in the privately owned lands would be developed, which equals development of 28 percent of the owls wintering habitat (Id).

Lastly, adult owl mortality is alarmingly high for such a small population. Seven out of twelve birds with radio telemetry died in a CDFG study between 2005-2007 (a 58 percent mortality rate). Autopsies found lesions on the heart or throat, possibly from trichomoniasis (Stermer 2010). Great grays are also thought to be extremely vulnerable to West Nile virus (Keane, personal communication). Auto collisions are another significant source of adult mortality. Approximately twenty-six great gray owls have been reportedly hit by vehicles in the greater Yosemite area between 1955-2005, including at least twelve in Yosemite since 1985 (Maurer 2005)

**Desired Condition**

- Great gray owl populations are stable or increasing.
- Great gray owl protection and conservation is a priority in the region. Because of the rarity and threat faced by this bird, conservation of this species takes precedent over resource management,(besides fuels reduction to address public health and safety).
- Meadow habitat provides high levels of the preferred prey species.
- Meadow vegetation and stream course condition are restored to the best possible functioning condition in all great gray owl territories.
- The autecology of the Yosemite great gray owl population is well understood.

**Objectives**

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- Enhance and restore the meadow environment; prey habitat is the highest priority in meadows and meadow complexes with current and historic occupancy.

- Consistently manage meadows and meadow complexes associated with great gray owl breeding detections. Meadows and meadow complexes should be managed to provide for suitable great gray owl breeding habitat if birds are detected at meadow, regardless of the boundary of the protected activity center (PAC).

- Manage the forested areas of PACs for dense understory within 500 feet of any nest sites. Within the Community Zone, manage surface and ladder fuels outside 500-foot nest buffer. Do not reduce canopy cover of trees over 20” as these trees rarely contribute to extreme fire behavior (North et al. 2009). Outside of defense zone, manage forested area for maximum canopy cover, multistory canopy, and large snags.

**Conservation Measures**

- Conduct surveys following accepted protocols (Keane et al. 2011) for great gray owl prior to all vegetation management affecting mature forest within 1,000’ of the edge of a meadow that is 15 acres or greater in size, activities that affect meadows of this size directly such as grazing, or post-fire activities within the species range. Revisit known territories and sightings in meadows affected by annual operating instructions (AOI) for grazing permits prior to approval of the AOI.

- Evaluate opportunities to create nest structures where they are limiting in suitable habitat.

**Delineation of Protected Activity Centers (PACs)**

- All units should delineate great gray owl PACs in the same manner to include the following (Beck 2001):
  a. Establish and maintain a protected activity center (PAC) that includes the forested area and adjacent meadow around all known great gray owl nest stands (USDA Forest Service 2001).
  b. While territorial occupancy (a pair, resident single, or sign such as a feather or pellet found during the breeding season) may be found without signs of nesting, it should be considered to indicate a nest territory, depending on the habitat. Nest stands may be defined by territorial occupancy because Great Gray Owls typically do not nest every year and occupancy status changes from year to year are not unusual.
  c. Include entire acreage of meadow margin (roughly a 200 yard zone of forest edge surrounding the meadow) be managed for nesting habitat. Note that historic nests have been found in inclusions of CWHR types 6, 5D, 5M, and 4D as small as 1/8 acre.
  d. Also include the meadow or meadow complex that supports the prey base for nesting owls (USDA Forest Service 2001). Delineate the entire meadow or meadow complex breeding owls are detected at. In total, 1,000 acres of forest and meadow may be needed to sustain a pair. Delineate great gray owl PACs to encompass entire meadow the nest site or detection is associated with. Include nearby stringer meadows or other possible foraging areas such as recent burns, failed plantations, grasslands, etc. The percent of meadow depends on habitat condition. Habitat condition can vary greatly from site to site and from year to year. Within territories, pellets/feathers/fecal spots/sightings/telemetry locations are typically found throughout the meadow or meadow complex most adjacent to a nest stand. The size of an adjacent meadow or

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meadow complex varies greatly for the species from 25 acres up to and including meadows hundreds of acres in size. Note that meadows that provide suitable foraging habitat at the lower end of range of meadow sizes (i.e. 25-30 acres) are typically in very high ecological condition (e.g., Crane Flat, Yosemite National Park).

e. Delineate a minimum of 50 acres (USDA Forest Service 2001) and up to several hundred acres (Beck 2001) of the highest quality nesting habitat.

Table A-13. Land allocations specific to great gry owl conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protected Activity Center (PACs)</td>
<td>Designation around known nesting sites for California spotted owl (300 acres) and great gray owl (&gt;50 acres). Inclusion in PAC of area within 300 feet of structures is avoided.</td>
<td>Provide habitat conditions to support successful reproduction. Manage for very low risk of loss of occupancy</td>
</tr>
</tbody>
</table>
**Mechanical Operations in Forested Areas**

- Retain all possible nest trees including all snags in PACs. If snags must be cut for safety, leave logs on site. Consider topping snags with sound base at least 15’ high.

- Maintain 70-100 percent canopy closure in the forested areas of the PAC (Beck and Winter 2000).

- A 500-foot buffer around the nest trees should be managed to limit habitat alteration, i.e., no mechanical activity and limited hand work associated with controlled burning. Maintain the existing canopy cover in the immediate area of the nest trees, where nesting birds and fledging young are most likely to occur. Fledgling owls need multi-story vegetation and leaning trees to climb up off ground and for cover (Bull et al. 1988, Jon Winter, personal communication).

- Maintain a limited operating period (LOP) between March 1-August 15 within ¼ mile of a great gray owl nest stand or PAC boundary if the nest can’t be located, unless surveys confirm birds are not nesting. The LOP applies to all mechanical activities, including road repair, motorized recreational events, increased haul truck traffic on roads, etc. unless a biological evaluation documents that such projects are unlikely to results in breeding disturbance considering their intensity, duration, timing an specific location. Where a biological evaluation determines the nest site will be shielded from planned activities by topographic features that minimize disturbance, the LOP buffer may be reduced. The LOP may be waived to allow for early season prescribed burning in up to 5 percent of the PACs on a national forest per year (modified from USDA Forest Service 2001).

- Limit additional recreational activities or developments such as roads or campgrounds in the PAC and areas within approximately ½ mile of the PAC and the associated meadow.

**Meadow Management**

- Exclude meadows associated with great gray owl PACs from grazing allotments and fence if necessary to exclude cattle. If grazing must occur, maintain stubble heights at a minimum of 12,” measured at the end of the grazing season (USDA Forest Service 2001). Avoid grazing in the meadow prior to September.

- Enhance small stringer meadows in and around the PAC through conifer removal, grazing reduction, and limiting OHV or other recreational use.

- Maintain or enhance the condition of the streams associated with meadows in PACs. Set a high priority on the repair of gullies, head cuts, soil compaction, stream bank instability, and avoid grazing on riparian vegetation.

- Enhance meadow and riparian vegetation to support prey species in meadow such as voles. Control conifer encroachment into meadows. Conifers in the meadow provide perches for foraging, but can also shade and dry the meadow. Periodic thinning may be beneficial, but consider retaining tall stumps or girdling trees to retain perch values for areas where meadow is more than approximately 200’ wide (Beck and Winter 2000).

- Fencing is valuable for controlling grazing, but may adversely affect owl movement. Where possible, remove unused fences from within and around the meadows.

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Other Recommendations

- Convene a multi-agency and stakeholder group to evaluate opportunities to protect and restore great grey owl habitat on public and private land.
- Develop a conservation plan to address habitat needs and species management across all ownerships.

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Northern Goshawk (*Accipiter gentilis*)

**Issue Statement**

The northern goshawk (*Accipiter gentilis*) occurs throughout North America, from Alaska throughout Canada and the U.S., and into Mexico. Although it is a large raptor, the size of a red-tailed hawk, the goshawk is remarkably maneuverable on the wing, able to chase down prey in dense understory. This fierce hunter is also vulnerable to human activity. Logging threatens breeding and foraging habitat throughout the U.S., including the Sierra Nevada (Squires and Reynolds 1997, USDI FWS 1998, Andersen et al. 2005, Keane 2008, NatureServe 2012). For this reason, it is a Forest Service designated sensitive species in Region 5, a State Species of Special Concern. The goshawk is also ranked S3 by NatureServe in California.

The U.S. Fish and Wildlife Service (FWS) released a status review of goshawk in 1998 and announced that protection under the federal endangered species act was unwarranted. Recent examination of the status review by the academic and professional community (Andersen et al. 2005) as well as examination of how earlier research was misapplied to goshawk habitat management (Greenwald et al. 2005) has reinvigorated dialog about goshawk conservation. While goshawks are charismatic and renowned they also remain secretive and difficult to understand and manage for. Here, we present science-based management recommendations and summarize current knowledge of their habitat needs.

**Distribution and Ecology**

**Elevation Range:** Goshawks breed in the Sierra Nevada from about 2,400’ to over 10,000’ and on the east side. Birds living at higher elevations during breeding likely move down slope during winter (Keane 2008).

**Habitat:** Goshawks occur primarily in ponderosa pine/mixed conifer vegetation types on the west side of the Sierra Nevada. On the east side, they inhabit Jeffery Pine or ponderosa pine, and occasionally hardwoods such as aspen (Keane 2008).

a) **Reproductive Habitat:** The most consistent vegetative characteristic of goshawk nest sites is dense canopy closure (Zeiner et al. 1990, Squires and Reynolds 1997, Desimone and DeStefano 2005). Nest stands are typically characterized by high canopy cover on gentle to moderate slopes with an open understory (USFS 2001). When compared to random plots, stands preferred by goshawks for nesting and roosting (in west side vegetation types), are characterized by (Squires and Reynolds 1997, Hargis et al. 1994, Keane et al. 1999, Maurer 2000, USDA Forest Service 2001):

- Greater basal area than random plots
- Greater numbers of large live trees (trees > 24” dbh)
- Greater canopy cover (mean = 65 percent and 70 percent Keane et al. 2006, Maurer 2000)
- Higher than average numbers of very large, old, trees (mean = 17 trees/ac > 40” dbh)
- Open understory with significantly lower numbers of trees less than 12” in dbh

Possible explanations for goshawk affinity to closed canopy conditions include protection from predators, reduced exposure to cold or hot temperatures, increased food availability, reduced competition for nest location by other large birds (ravens, red-tailed hawks) (Andersen et al. 2005).

Breeding habitat has been studied at several different scales. It appears that goshawks need high canopy cover and old forest structure with minimal fragmentation at the 50, 120, and 420-acre scales. At the 50a stand scale, nest trees are the largest trees in a stand with dense canopy cover and open understory (Keane 2008). Goshawks
typically nest in the lowest branches of a large tree, and they use an open understory to nest, perch and hunt (Ibid). Goshawks build multiple stick nests and can maintain up to eight alternate nests in one territory, sometimes in several different nest stands (Squires and Reynolds 1997). These alternate nests are important for land managers to find and protect even if they are unoccupied for years at a time (Andersen et al. 2005, Weber 2006).

At the 100-200 acre scale, persistence of active nest areas over time are associated with less than 50 percent old forest cover (Desimone and DeStefano 2005) and are inversely associated with forest fragmentation (Woodbridge and Detrich 1994). Reynolds et al.(1992) recommends maintaining at least 40 percent old forest cover at the 420-acre post-fledgling area (PFA) scale in Arizona. Whether these recommendations retain sufficient cover to sustain goshawks has not been determined (Greenwald et al. 2005).

Goshawk use of open areas for hunting at any scale is poorly understood. Therefore, management related questions persist, such as: how much old forest do goshawks need to survive and reproduce? And, do goshawks use or need open areas to hunt? Some studies document avoidance of open areas, while others document no preference during hunting (Reynolds et al. 2008). For example, breeding has been documented for several seasons following the die-off of trees affected by beetles near nest stands (Squires and Reynolds 1997). Perhaps some burned areas still provide old forest structure and an ephemeral pulse of resources goshawks can capitalize on for a few years. Because old forest cover has been greatly reduced throughout the Western U.S., it is important to protect old forest cover where it still exists until habitat needs are better understood (Greenwald et al. 2005).

The U.S. Forest Service in Region 5 protects 200 acres as goshawk breeding territories, but does not protect habitat at the 420 acre post-fledgling scale. Impacts of forest management on goshawk territories at this scale are unknown and represent a risk to the species (Keane 2008). We do know that goshawks select for old forest habitat at this scale to raise their young, so in light of this uncertainly surrounding forest management impacts, we recommend maintaining preferred breeding habitat at this scale as well.

b) Foraging Habitat: Foraging habitat preferences of goshawks are poorly understood, although limited information from studies in conifer forests indicate goshawks prefer to forage in mature forests (Squires and Reynolds 1997) with greater canopy closure and greater density of large (>40"dbh) trees relative to random plots (Hargis et al. 1994). Foraging habitat structure must allow a large bird ease of hunting near an open forest floor. Although controversy exists over management guidelines that identify goshawk foraging habitat as early seral areas of high prey density (Squires and Reynolds 1997), these associations were based on very little research (Squires and Reynolds 1997). Subsequent peer review supports the notion that goshawks forage in old forest and select foraging areas based on forest structure, not on prey availability (Andersen et al. 2005, Greenwald et al. 2005). Indeed, some of their key prey species are also associated with old forest such as Douglas tree squirrels.

**Diet:** Goshawks feed on a variety of birds and mammals. The following are important contributors to the biomass of their diet: Douglas tree squirrels, golden-mantled ground squirrels, Belding ground squirrels, Western gray squirrels, hares, rabbits, chipmunks, robins, flickers, Steller’s jays (Keane 2008, Keane et al. 2006, Fowler 1988).

**Reproduction:** Goshawks have high mate and territory fidelity (Weins et al. 2006). Nest locations may alternate each year within one territory. A breeding pair may maintain up to eight alternate nests (Squires and Reynolds 1997). They are strongly sexually dimorphic with the females approximately 60 percent larger than males (Ibid). The larger females defend the nest and males provision nest (Ibid).
Goshawks usually begin breeding at three years of age and have one brood per season (Squires and Reynolds 1997). Courtship starts around mid-March and eggs are laid in late April. Eggs hatch one month later in late-May. By late June, juveniles are one month old and have adult feathers. Juveniles learn to hunt in the post-fledgling area through the fall. Prey availability is strongly limiting for juvenile survival (Wiens et al. 2006). Maximum life span is at least 11 years (Squires and Reynolds 1997).

Goshawk reproductive success is closely associated with tree squirrel populations (Keane et al. 2006, Wiens et al. 2006, Salafsky et al. 2007) and annual weather patterns, particularly late winter temperatures (Keane et al. 2006). Considering that tree squirrel densities follow the previous year’s pinecone crop, the importance of old forests is underscored because older conifers tend to produce more abundant and frequent cone crops (Keane et al. 2006).

**Predators:** Goshawks are large and aggressive birds with few natural predators. The great-horned owl is one, although female goshawks are the same size and will attack a great horned owl to defend its nest. Interspecies predation is also documented (Squires and Reynolds 1997).

**Home Range:** Mean female breeding home range size on the west slope of the Sierra is 4,980a and 6,664a for males. Non-breeding home ranges are 13,776a for females and 20,317a for males (USDA Forest Service 2001). On the east side, mean female breeding home range is 3,310a and 5,928a for males (Id). Dispersal distances have been recorded up to 60 miles (NatureServe 2012).

Breeding home ranges are described as several core habitat areas including the nest areas and key foraging areas. Home ranges outside the nest areas are not defended and can overlap with other birds. However, goshawks are territorial and nests belonging to different territories do not occur closer than 1 mile from one another. This is helpful information for land managers to choose survey areas for new nests. If a known nest occurs within less than a mile of suitable habitat, then it can safely be assumed there is no new goshawk breeding territory in that area (Keane 2002).

Little is known about goshawk use of home ranges. In 2001, the Forest Service struggled with how to provide adequate habitat at this scale, and concluded that there is not enough information to determine if management guidelines for home ranges provide adequate habitat (Ch.3 pt. 4.4 pg 128). Currently, the Forest Service does not manage for goshawk at the home range or PFA scale.

**Demography:** Demography studies on goshawks are limited. In 1998 the U.S. Fish and Wildlife Service (FWS) completed a status review for the northern goshawk and announced its finding that there is “no evidence that the goshawk population is declining in the western United States…” and that in California “population data available…are inadequate to allow determination of any current trends in goshawk populations in California.” (1998). The FWS finding raised significant concern in the professional and academic community, resulting in a technical review sponsored by the Wildlife Society and the Raptor Research Foundation (Andersen et al. 2005). Reviewers found that the FWS inappropriately and inaccurately estimated population trend, population growth rates, species distribution, habitat distribution and habitat trends (Ibid). In some cases, agency determinations were found to be speculative rather than evidence-based (Ibid). The status and distribution of goshawk populations, especially in California, remains largely unknown. Breeding populations occur in small numbers throughout northern California and the Sierra Nevada, but these small populations are vulnerable to any number of stochastic events and other threats (Id).
**Threats**

The following are likely to contribute to goshawk population instability:

**Logging/Habitat Loss:** A primary conservation concern for goshawk is loss of breeding and foraging habitat due to logging throughout the U.S., including the Sierra Nevada (Squires and Reynolds 1997, USDI FWS 1998, USDA Forest Service 2001, Andersen et al. 2005, Keane 2008, NatureServe 2012). In southern Oregon, researchers tracked nest activity over a 20 year period and found that low occupancy rates by some territories was due to loss of nesting habitat from logging (Desimone and DeStefano 2005). In another study, territory occupancy is closely associated with patch size of old forest patch sizes at the nest stand scale (Woodbridge and Detrich 1994). Goshawks require old forest throughout their breeding territory and PFA in order to produce young.

**Noise and Nest Stand Disturbance:** Goshawks are extremely sensitive to noise and human presence in or near the nest stand during pair bonding, nest-building and incubation (Squires and Reynolds 1997, Keane et al. 2006). Nest failure has been repeatedly documented from research visits to nest areas before June (Keane et al. 2006). Even camping near nests can cause failure (Squires and Reynolds 1997). Noise and disruption associated with timber harvest operations (e.g., logging equipment, log truck traffic, road construction, timber cruising) can also cause nest failure even after nestlings have almost fledged in late June (Id). Unusually heavy road traffic or OHV use have the potential for similar negative impacts (USDA Forest Service 2001).

**Population Size:** Keane (2008) describes five areas of concern in California where goshawk extirpation is a risk due to range contraction or small breeding population. Three of these areas are located in the Sierra Nevada: east side pine zone, west side ponderosa pine zone and the Southern Sierra Nevada. In the first two pine zones, extensive logging has removed conifer habitat used by goshawks. In the Southern Sierra south of Yosemite National Park, goshawk sightings are limited and uncertainty exists as to the cause. Possible explanations include low survey effort in the area, low breeding densities, or a recent range contraction (Id). Rodenticide may also contribute (see item g below).

**Nestling Survival:** Weather patterns in conjunction with prey dynamics appear to be a primary factor affecting goshawk reproduction and survival. Prey availability is also key to fledgling survival during their first winter (Wiens et al. 2006). Late winter storms can cause nest failure for the year. If global climate change leads to a trend toward colder wetter springs and late season storms, it would also have the potential to negatively affect goshawk demography.

**Urban Development:** Development on the west slope often results in goshawk habitat loss and sometimes disturbance to nearby breeding territories. Recreation activities such as off-highway vehicles (OHVs) can also be a significant disturbance to breeding territories during the late spring and early summer (Keane 2008).

**Falconry:** Falconers are permitted to take goshawk nestlings from the wild by California Department of Fish and Game. This activity does not appear to threaten statewide goshawk numbers except on the east side Inyo National Forest where repeat harvest from only a few areas may jeopardize persistence of individual territories (Bloom et al. 1986, Keane 2008).

**Rodenticide/Poison:** Raptors and other predators are vulnerable to rodenticides because they bio-accumulate in prey tissue. Second generation anti-coagulant rodenticides (e.g., D-Con) have been reformulated with greater lethality and potential for bio-accumulation than first generation poisons (e.g., strychnine).

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Rodenticides are liberally used on marijuana plantations across the Sierra Nevada. Poison is poured all over grow sites and irrigation hose lines. Non-target effects have been documented in many wildlife species, including a close relative of the goshawk, the Cooper’s hawk, as well as golden eagle, barn owl, red-tailed hawk, red-shouldered hawk, great-horned owl and a myriad of rare and common mammals. Impacts to goshawk are likely but presently unknown.

**Desired Condition**

- Goshawk populations are stable or increasing.
- Goshawk breeding and foraging are met at the appropriate spatial and temporal scales.
- Old forest cover is widespread and habitat fragmentation is limited.
- Prey species, such as squirrels and flickers, are abundant and sustain goshawks throughout their life cycle.
- Prey habitat such as older conifer and mixed conifer forests, large snags and logs, meadows, and riparian areas sustain a variety of rodent and bird prey eaten by goshawk.
- Goshawks are undisturbed by human activity during breeding.

**Objectives**

- Maintain existing nesting structures and nest tree recruitment (especially pine species).
- Maintain dense canopy cover and open understory structure throughout most of the post-fledgling area (PFA).
- Maintain forest structure for hunting and foraging throughout the PFA.
- Conduct landscape assessments to identify restoration opportunities to increase old forest cover and continuity.
- Limit disturbance to goshawks during breeding near nests.
- Monitor project-level responses of nesting goshawks to management treatments (Keane 2008). Conduct implementation and effectiveness monitoring for goshawk habitat on a project basis (US Fish and Wildlife Service 1998).

**Conservation Measures**

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, provisions for understory vegetation, large wood and large snags, and establishment of post-fledgling areas (PFAs) and limited operating periods.
- Use managed fire to the maximum extent possible to create variability in forest structure.
- Designate goshawk post-fledging areas (PFAs) of approximately 420 acres in size around nest sites.

Table A-14. Land allocations specific to northern goshawk conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>General Description</th>
<th>Management Objective</th>
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<tbody>
<tr>
<td>Post Fledgling Area (PFA)</td>
<td>Area (420 acres) around northern goshawk nest stand. Delineated around all birds known to be nesting.</td>
<td>Manage for breeding and nesting; area intended to support fledglings. Mature forest, large tree structures (live and dead), open understories. See Appendix A for additional details on desired habitat conditions.</td>
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• Manage PFAs to maintain or enhance dense canopy cover, basal area, open understory, large old conifers, and snags, downed logs, riparian and meadow habitat for prey species (Salafsky et al. 2007) such as tree squirrels, ground squirrels, flickers, jays and robins.
• Maintain canopy cover in nest stands and post-fledgling areas at or above 60 percent to support goshawk reproduction and juvenile survival.
• Conduct mechanical treatment in PFAs only to meet fuels objectives. Retain large snags and downed trees on site as prey habitat.
• Conduct surveys in suitable habitat for goshawk prior to project planning and mechanical activity. Identify and protect all alternate nest sites as well as active nests. Surveys should extend 0.5mi outside project boundaries (Youtz et al. 2007).
• Vegetation treatments are conducted in no more than 5 percent per year and 10 percent per decade of the acres in goshawk PFAs by watershed and district.
• Restrict mechanical activities including recreation during the critical nesting and fledgling periods (March 1 through Aug. 15) within 0.25 mi. of nest stands. Restrict nest stand entries until at least June 1. Potentially disturbing activity includes mechanical equipment, unusual vehicle traffic, camping or parking areas, non-motorized traffic, etc.

Other Recommendations

• Review new research on goshawks with an expert panel and modify or add new goshawk management standards as recommended.
• Conduct radio telemetry studies to increase understanding of foraging habitat and prey use in both the breeding and winter periods (Keane 2008).
• Develop empirically derived habitat models to monitor change in habitat distribution and quality at home-range and landscape scales (Keane 2008).
• Conduct basic demographic research to understand how survival and reproduction are affected by interactions among habitat, prey, weather, and possibly disease such as West Nile virus (Keane 2008).
• Investigate rodenticide impact on goshawks in the Sierra Nevada.
• Establish and annually update and manage a statewide nesting record database for tracking distributional patterns and assessing conservation status across state, federal and privately managed lands (Keane 2008).
• Advocate that Calif. state EPA and federal EPA list the second generation rodenticides as “restricted use materials” so that they are not available over the counter at farm supply stores without a license and other regulatory oversight.

References


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Pileated Woodpecker (*Dryocopus pileatus*)

**Issue Statement**

Pileated woodpecker is a species of concern in the forests of the Sierra Nevada because it is an old-growth associate and snag-dependent species requiring large areas for territories, and is especially vulnerable to both local- and landscape-scale habitat alterations. Pileated woodpecker (*Dryocopus pileatus*) numbers are thought to be declining in the Sierra Nevada as a result of logging mature forests and cutting snags (Verner and Boss 1980, Harris 1982). Grinnell and Miller (1944) summarized the status of this species as "diminishing about commensurately with extension of lumbering operations." The availability of large snags and large decaying live trees necessary for nesting and roosting by pileated woodpeckers has declined in many areas as a result of forest conversion and timber management practices (Bull and Jackson 1995, Ferguson et al. 2001). In Eastern Oregon, where forests underwent extensive regeneration harvests, pileated woodpecker density dropped by 80 percent (Bull et al. 2007).

The pileated woodpecker is also a keystone species (Aubry and Raley 2002b). As primary cavity excavators, they create habitat for more than two dozen forest species and secondary cavity nesters (individuals that use cavities but do not create them) (Raphael and White 1984, McClelland and McClelland 1999, Bonar 2001, Aubry and Raley 2002a). They also facilitate heart-rot through their excavating and foraging activities and are the primary architects of snag development (Aubry and Raley 2002b).

Pileated woodpeckers require extensive forests containing large mature diseased trees and snags, dense forests, and a forest floor littered with decaying wood (e.g. Bull 1975, Schroeder 1982). Ideal habitat provides a relatively humid environment (such as streamsides) that can promote fungal decay and sustain the ant, termite, and beetle populations on which these birds feed. Pileated woodpeckers primarily eat carpenter ants excavated from dead or decayed sap- or heartwood (Bull et al. 1986) but they also eat a variety of beetles and other insects and smaller amounts of plant foods (less than 30 percent) (Beal 1911 in Zeiner et al.1988). The duration of decay states and size of tree are often correlated.

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Population data such as the Breeding Bird Survey are not available with precision for pileated woodpeckers in the Sierra Nevada but existing data suggest a stable population (Sauer et al. 2011). Pileated woodpecker are ranked G5 (globally secure) by NatureServe, primarily due to the widespread distribution of pileated woodpecker in North America.

**Distribution and Ecology**

The pileated woodpecker is a widely distributed species and year-round resident ranging from northern British Columbia, across Canada to Nova Scotia, south through central California, Idaho, Montana, eastern Kansas, the Gulf Coast and Florida (Bull and Jackson 1995). The California range of the pileated woodpecker extends from the Oregon border in Siskiyou County, south in the Coast Range region to Sonoma, Marin, Santa Cruz and western Santa Clara Counties, and to Howell Mountain in Napa County. It ranges inland from the Mount Shasta and Lassen Peak region south throughout the Sierra Nevada to the Greenhorn Mountains in Tulare and Kern Counties (AOU 1998, Grinnell and Miller 1944, Small 1994). Small (1994) also reported occurrences of this species in Alameda and Contra Costa Counties. Although Grinnell and Miller (1944) considered it to be a fairly common resident, Small (1994) described it as a rare to uncommon resident.

**Habitat Characteristics**

In the western region of North America, the pileated woodpecker is almost exclusively found in mid- to late seral conifer-dominated forests (Mellen et al. 1992, Bull and Holthausen 1993). A research team studying pileated woodpeckers in the Lassen and Plumas National Forests concluded that canopy closure is the single best predictor of the presence of pileated woodpecker. Pileated woodpecker were found to be significantly more abundant in 1,000 acre Spotted Owl Core areas than elsewhere (PRBO 2007, 2008). However, research in Eastern Oregon found that canopy reduction from natural causes (insect outbreaks) did not affect pileated woodpecker density, as long as extensive logging and fuel reduction had not occurred (Bull et al. 2007).

Multiple studies identified old-growth or late seral forest as being important for the species (reviewed in Bull and Jackson 1995). Isolated large, dead trees amidst a younger forest may also be used for nesting (Bull and Jackson 1995). Nelson (1988) found pileated density was greater in forests over 80 years old with greater than 60 percent canopy closure. Stands at least 40 years old were preferred for foraging (Bull et al. 1992, Mellen et al. 1992).

Large snags are used for foraging, nesting, and roosting. The majority of nests are in large snags averaging 37 inches DBH with mean tree height of 108 feet (reviewed in Bull and Jackson 1995). Schroeder (1982) summarized two studies in the western United States, both of which reported the mean height of the nest tree as 92 feet. According to Schroeder’s Habitat Suitability Index Model, optimum pileated woodpecker habitat contains 30 or more trees greater than 20 inches DBH per acre within a minimum of 320 acres; optimum canopy closure is 75 percent or greater and stands with less than 25 percent canopy closure have no suitability for the species.

Some of the studies cited in the model document nesting pairs of pileateds in ranges as large as 600 acres. Average home range sizes of pairs in northeastern Oregon and western Oregon ranged from 1,006 acres to 1,181 acres, respectively (Bull and Jackson 1995). In conifer forests of northeastern Oregon, territories ranged from over 320 to 600 acres (130 to 243 ha); minimum density of 13 pairs was 1 pair per 1620 acres (656 ha) (Bull and Meslow 1977 cited in Verner and Bos 1980). Bull and Holthausen (1993) reported territory size for breeding pairs in the Blue Mountains averaged 407 ha (1006 ac) and was considered an adequate size to manage for each
breeding pair in that region. Long term studies in the region (>30 years) suggest that the same home ranges can be managed for pileated woodpeckers for decades, if large snags and logs exist or are retained (Bull et al. 2007).

Pileated woodpeckers rarely re-use cavities from year to year, and eleven or more roost cavities are used within a year by individual birds (Bull et al. 1992). Bull et al. (1992) found 95 percent of roost cavities had a hollow interior created by decay rather than excavation. In Oregon and Washington, the mean height of the nest hole ranged from 49-125 feet above the ground (Bull and Jackson 1995, Schroeder 1982).

Pileated woodpeckers occupy the same home ranges for up to 30 years and possibly for two to four generations. Density of pileated woodpeckers decreased 80 percent after extensive tree harvesting. Pileated reproductive success appears to be closely tied to the amount of unharvested, closed-canopy stands, and reproductive failure appears tied to the amount of harvested stands. High tree mortality is not detrimental to pileated woodpeckers if abundant large snags persist (Bull et al. reviewed in Parks 2009).

Nest tree species frequently chosen by the pileated woodpecker in Oregon include ponderosa pine and Douglas fir. Pileateds have also been documented using large aspen for nesting (Carriger and Wells 1919, Grinnell and Miller1944, PRBO 2007). Over 70 percent of nest cavities in northeastern Oregon faced between a northeasterly and southwesterly direction (Bull and Jackson 1995).

Pileated woodpecker forages extensively on carpenter ants (*Camponotus* spp.), which are prevalent in decaying downed woody material in coniferous forests of the west (Bull and Jackson 1995). A study in Oregon found that 38 percent of foraging was on down logs and that they selected for logs with a diameter greater than 15 inches with extensive decay (Bull and Holthausen 1993, Torgersen and Bull 1995).

Prescribed fire may have negative short-term impact on pileated woodpecker because of the reduction in down wood and direct killing of carpenter ants (Bull et al. 2005). Mechanical treatments also significantly reduced snags and down wood but did not impact foraging by pileated woodpecker as much as areas that were mechanically treated and then burned. Fuel treatments should make stands more resilient to high intensity fire while maintaining large down wood, snags, and relatively high tree density (Bull et al. 2005).

Habitats with high densities of down logs and snags are preferred. Schroeder (1982) summarizes one Oregon study where pileated woodpeckers spent 36 percent of their feeding time foraging on logs, 35 percent on live trees, and 29 percent on snags. Typically, the male and female each digs and uses its own roosting cavity (Terres 1980), which may be separate from the cavity used by the pair for nesting. Over a 10-month period, individual birds may utilize an average of seven (range 4-11) different trees for roosting purposes (Bull and Jackson 1995). The number of snags needed to support maximum pileated woodpecker populations have been estimated by several researchers and include the following recommendations (Schroeder 1982): 18-26 inches dbh snags at a density of 0.24 snags/acre; snags greater than 20" dbh at a density of 0.14 snags per acre; and snags greater than 20 inches dbh at a density of 0.13 snags per acre. Schroeder's (1982) habitat model assumes that optimum or maximum pileated woodpecker habitat contain 30 or more trees greater than 20 inches dbh per acre; 10 or more logs greater than 7 inches diameter and/or stumps of the same diameter and greater than 1 foot high per acre; 0.17 or more snags per acre, where a snag is defined as greater than 20 inches dbh. PRBO (2007) found optimal habitat where the average DBH of all snags greater than 20 inches is 30 inches, and recommends retention of all snags in occupied pileated habitat (PRBO 2007).

In California, this species has been documented at elevations as low as 500 feet and as high as 7500 feet (Grinnell and Miller 1944). Most nests are within 164 feet of water and no farther than 492 feet from water (Schroeder 1982).
Pileated woodpeckers breed at age 1. Mean annual adult survival over an 8-year period in northeast Oregon was 64 percent with a 35.40 percent standard deviation (Bull and Jackson 1995). Pileated woodpeckers may live for up to nine years. To date, there are no estimates of the minimum viable population size for this species (Jackson et al. 1998).

**Ecological Role**

Recent research indicates that pileated woodpeckers are a keystone species in western forests (Aubry and Raley 2002b). It is the only species capable of creating large cavities in trees and snags, and the only species which forages exclusively by excavating. These cavities produce habitat for dozens of species, including many of management concern due to their rarity and endangerment. Pacific fisher commonly uses cavities excavated or expanded by pileated woodpeckers for natal or pre-weaning dens (Aubry and Raley 2006, Higley and Matthews 2009).

In addition to primary excavation of large new cavities in live trees or snags for nesting, pileated woodpeckers also expand openings within trees that are hollowed out by advanced decay by heart-wood fungi. Their foraging and excavating activities provide dispersion of heartwood fungi (e.g., Aubry and Raley 2002b).

Pileated woodpeckers create a relatively large nest cavity for nesting in live trees or snags that have been softened by heartwood decay and, for roosting, excavate openings into portions of trees that have been hollowed out by advanced decay (Bull et al. 1992, McClelland and McClelland 1999, Aubry and Raley 2002a). Also, through both cavity and foraging excavations, woodpeckers may facilitate the inoculation of live trees with heart-rot fungi (e.g., Aubry and Raley 2002b).

Because of its role as a keystone species and its strong association with large snags and decadent live trees, the pileated woodpecker may be a particularly appropriate ecological indicator for effectiveness monitoring of species associated with late-successional forest conditions such as the Pacific fisher and California spotted owl as well as secondary cavity nesting species. Secondary cavity nesters are almost wholly dependent upon the pileated woodpecker because it is the only primary cavity excavator in the forests of the Sierra Nevada. Approximately 45 of cavity-nesting birds and 10 mammal species on the west slope of the Sierra Nevada utilize snags for nesting habitat (Raphael and White 1984).

**Threats**

Threats considered to be most important to this species include: conversion of forest habitats to non-forested habitats; short-rotation, even-age forestry management; monoculture forestry; forest fragmentation; and removal of logging residue and downed wood from the forest floor. In particular, the removal of logging residue and downed wood takes away the nutrients and foraging substrates for pileated woodpeckers and also reduces the overall water content of the forest floor, making it less suitable for the arthropod fauna that this species is dependent on (Jackson et al. 1998). Rotting snags and decaying living trees that are crucial habitat for pileated woodpeckers are also most likely to be removed as hazards during timber harvest. Pileated woodpeckers did not utilize remnant 1.0 ha patches in regeneration harvest areas or clearcut areas, even after 25-30 years post-experimental treatment (Gyug and Bennett 1995 in Aubry and Raley 2002b).

Researchers in the Lassen-Plumas National Forests found basal area in occupied sites averaged 170.40 sq. ft. for pileated woodpecker, compared to 117.40 sq. ft. at unoccupied sites; and canopy closure at occupied sites averaged 49 percent compared to 37 percent at unoccupied sites.
Desired Conditions

- Pileated woodpeckers are stable or increasing in number.
- Pileated woodpeckers are of a sufficient number and distribution to provide an adequate supply of cavities for secondary cavity utilizing species.

Objectives

- Manage pileated woodpecker home ranges for long term, multi-generational occupation (Bull et al. 2007).
- Identify habitat areas to manage with the objective of increasing the numbers of pileated woodpeckers.
- Emphasize habitat management for the pileated woodpecker in riparian forested habitats along rivers and large streams; and on the western (more humid) slopes of mountains, where food and nest habitat attributes are most plentiful.

Conservation Measures

- Follow the recommendations for vegetation management in this conservation strategy, including limits to timber harvest, and provisions to retain understory vegetation, large wood and large snags.
- Within areas where modeling predicts high habitat suitability for pileated woodpeckers (>40 percent; see PRBO 2007) or that is otherwise considered suitable habitat for this species:
  - No even-aged timber management
  - Retain at least 150 sq.ft./acre basal area in treated stands
  - Manage to provide for home range habitat needs across areas ranging in size from 600-900 acres
  - Over half of the forested landscape should have canopy cover of 60 percent or greater
  - Limit timber harvest operations near known nesting sites or high concentrations of this species during the peak of the breeding season (April – June).
- As a general standard throughout forested areas:
  - Leave all snags over 18 inches DBH
  - Retain all large downed logs – pileated’s forage on carpenter ants in downed wood. Retain as much downed wood over 15 inches diameter as is feasible while meeting fuel reduction objectives. Priority should be given to the largest diameter material in a range of decay classes.
- Conduct population monitoring, utilizing techniques such as banding and recapture studies, telemetry studies, and other censuses. PRBO (2007) recommends employing active playbacks and road based surveying utilizing vehicles to move quickly between distant survey points.
- Conduct habitat monitoring, both within and across regions. Utilize and refine the habitat model developed by PRBO (2007) to manage for well distributed populations.
References


Aubry, K.B. and Raley, C.M. 2006. Ecological characteristics of fishers (Martes pennanti) in the Southern Oregon Cascade Range. USDA Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory, Olympia, WA.


Willow Flycatcher (*Empidonax trailli*)

**Issue Statement**

The willow flycatcher (*Empidonax trailli*) is a neo-tropical migrant songbird. In the Sierra Nevada it breeds in wet meadows and flies to Central America to overwinter. Willow flycatchers have recently been extirpated from the central Sierra on the Eldorado, Stanislaus, Humboldt-Toiyabe and Sierra National Forests, Yosemite National Park, and near-extirpation is reported in the Lake Tahoe Management Unit (Mathewson et al. *in press*). Meadow desiccation is the single most important factor in their decline, leading to increased nest predation, reduced nesting substrate, and reduced aquatic insect prey (Green et al. 2003). Willow flycatcher is listed as endangered under the California Endangered Species Act and is a Forest Service Sensitive Species.

Wet meadows are of the upmost importance for birds in the Sierra Nevada (Siegel and DeSante 1999) and yet they cover less than 1% of all Forest Service land here (Burnett 2009). In an environment where precipitation and annual stream flow are predicted to reduce dramatically, land managers must take proactive steps to protect and restore essential wet meadow habitats upon which so many species depend.

Three subspecies of willow flycatcher occur in the Sierra Nevada. Populations of *E.t. brewsterii* occur on the west slope and *E.t. adastus* occurs on the east side. The federally endangered Southwestern willow flycatcher (*E.t. extimus*) occurs in the southernmost areas along the South Fork Kern River and in the Owen’s Valley in the Eastern Sierra Nevada. The Sequoia NF has *E.t. brewsterii* on the west side and *E.t. adastus* on the east side. The Inyo NF may have all three species plus intergrades. Genetics research is needed in the Sierra Nevada to investigate differences between sub-species because a smaller study did not find significant differences between a few *E.t.adastus* and *brewsteri* populations within this bioregion (Green et al. 2003). With an annual population decline of up to 23%, and about 40% of all historic nest sites are now unoccupied, land managers and scientists are faced with sobering circumstances under which to prioritize goals, gather resources, and take action (Green et al. 2003; Siegel et al. 2008; Mathewson et al. *in press*).

**Distribution and Ecology**

*Elevation Range:* The majority of willow flycatchers (88%) breed between 4,000-8,000 feet in the Sierra Nevada.

*Habitat:* Willow flycatchers breed in montane wetland shrub habitat along riparian areas or in meadows. They require dense, tall willows (five to six feet) with standing water through mid-June for successful nesting (Green et al. 2003; Vormwald et al. 2011). These habitat elements are threatened by both natural and anthropogenic (human-made) causes. Management intervention is needed to protect and restore hydrologic function, and to sustain willow flycatchers in the Sierra Nevada.

  a) **Foraging habitat:** Willow flycatchers are restricted to foraging in riparian and meadow shrubs during the breeding season (Vormwald et al. 2011). Foraging behavior and habitat used during migration is unknown, but wintering habitat includes wetlands in Panama, Costa Rica, and El Salvador (Green et al. 2003).

  b) **Nesting Habitat:** Optimal nesting habitat has been has been described containing the following elements (Flett and Sanders 1987; Harris et al. 1987; Valentine et al. 1988; Green et al. 2003):
Standing water or heavily saturated soils near or under willows;
- Meadows of 10 acres or more;
- Willow shrub cover 60% of meadow;
- Willow shrubs with dense foliage at nesting height (five to six feet).

Nest success is associated with presence of the following habitat elements (Green et al. 2003):
- Greater willow shrub cover on entire meadow (50-60% vs. 43%);
- Deeper water depth;
- Greater willow shrub density (22% greater foliar density).

Nesting substrate is almost always Lemmon’s willow (*Salix lemmonii*) (Green et al. 2003). Willow flycatcher also use alder, aspen and wild rose for nesting in California (Sedgwick 2000). Notably, all nine recent nesting attempts in Rush Creek on the Inyo NF were in wild rose (Green et al. 2003).

**Diet:** Willow flycatchers feeding strategy is to ‘flycatch’ or take flying insect prey out of the air, and glean off of vegetation (Sedgwick 2000). Primary food items in the Sierra Nevada are 55% bees, wasps and flies. Other food items include grasshoppers, willow sawflies, deer flies, moths, caterpillars, mayflies and damselflies (Ibid; Green et al. 2003).

**Reproduction** (from Sedgwick 2000; Green et al. 2003): Willow flycatchers migrate annually from Central America to the Sierra Nevada in late May to early June. They are generally monogamous, and about nine percent of breeding males are polygamous. Males sing and defend territories and females build nests. Eggs are laid around mid-June to early July. Females do all of the brooding and care of hatchlings, and later males and females feed and tend to fledglings together. There is an approximately 40% nest success rate in the Sierra Nevada. Late nesting attempts are common with this species (12-35% of all nests), so nestlings can be in nests into early August if the first or second nesting attempt fails. Females do all of the brooding and care of hatchlings, and later males and females feed and tend to fledglings together. Fledglings stay in their natal territory for two to three weeks and birds leave for their wintering grounds by mid-September.

**Predators:** Common nest predators include chipmunks, tree squirrels, mice, weasels, jays, nutcrackers, and snakes. Willow flycatcher researchers are concerned about nest predation because it contributes to poor nesting success; between 30-70% of nesting attempts fail in the Sierra Nevada (Cain et al. 2003; Green et al. 2003; Cain et al. 2006; Mathewson 2010). The central Sierra experiences higher nest predation rates, sharply reducing fecundity (Mathewson 2010).

High nest predation rates appear to be driven by particular meadow vegetation and moisture conditions. Tree squirrels and chipmunks are strongly associated with lower densities of shrub foliage, dry soils, conifers, downed woody debris, and sagebrush in meadows (Cain et al. 2003; Green et al. 2003; Cain et al. 2006; Mathewson 2010), and are excluded by standing water (Cocimano et al. 2011). Chipmunks and squirrels occur within 300 feet of conifer trees along meadow edges (Cain et al. 2003). Even a single conifer tree can provide cover for squirrels and chipmunks to foray into the middle of meadows (Green et al. 2003).

Nest predation rates are lower in the northern Sierra where willow flycatcher densities are higher, possibly because of a density-dependent protection birds enjoy there (Mathewson 2010). Another explanation for lower nest predation rates in the northern Sierra is that birds there have a longer breeding season, enabling them to attempt nesting several times in a breeding season (Ibid). Alternately, nest predator densities may be unusually high locally for other reasons, such as an absence of larger predators or unknown augmentation of local nest predator populations (Ibid).

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Nest parasitism by brown-headed cowbirds is also a conservation concern for willow flycatchers. Cowbird parasitism rates are relatively low across the Sierra Nevada (Green 2003), however, local rates can be alarmingly high in the southern and eastern Sierra Nevada (Green et al. 2003; Heath et al. 2010). Cowbirds lay their eggs in host nests and can kick out host eggs. Cowbird hatchlings also kill host nestlings and host parents care for cowbird young instead of their own. Land managers have successfully removed cowbirds from the Kern River Preserve in the southern Sierra Nevada.

Home Range: Average breeding territory size varies from the northern (0.8 acres) to southern (1.5 acres) Sierra Nevada (Flett and Sanders 1987; Green et al. 2003). Post-fledgling territory size ranges from one to eight acres (Vormwald et al. 2011). Records of adult dispersal from natal sites are rare, but birds have been recorded breeding 0.6 to nine miles from their natal territory (Ibid).

Demography: Current estimates put the Sierra Nevada population at 300-400 individuals (Green et al. 2003). In 2003, 53 of 130 known breeding sites had been lost since records began at the turn of the century (Ibid). The heaviest losses are in the central Sierra from Lake Tahoe to Yosemite National Park. Six nesting sites are left supporting over 75% of all active territories: Perazzo meadow and Little Truckee meadow (USFS owned with E.t. brewsteri), Lacey Valley (privately owned with E.t. brewsteri), Warner Valley Wildlife Area (CDFG owned with E.t. brewsteri), and finally, the South Fork of the Kern River and Owens Valley (USFS owned with E.t. extimus). Higher nest predation rates and later onset of breeding in the central Sierra has sharply reduced nesting success and fecundity (Mathewson 2010).

Estimates of population growth ($\lambda$) for Sierra Nevada willow flycatcher vary between sites (0.77 to 0.99), but always indicate an annual decline of 1-23% (Green et al. 2003; Mathewson et al. in press). During a 12 year period from 1997 through 2008 a Sierra Nevada study reported a 1.9% annual decline in the Warner Creek population, a 6.1% annual decline in the Tahoe National Forest population, and a 17.9% annual decline and near extirpation of the species from the Lake Tahoe Basin Management Unit, and Humboldt-Toiyabe National Forest (Region 6) (Mathewson et al. in press). Several reasons for these rapid declines are under investigation. Habitat isolation does not appear to be a factor. The maximum distance between breeding sites today is 27 miles, the maximum dispersal distance during breeding is 118 miles in E.t. extimus (Green et al. 2003). Furthermore, losses in wintering grounds or migration are similar to other neo-tropical migrants (Ibid). Causes of decline most likely are linked to breeding habitat quality and nesting success. A recent research synthesis (Ibid) concluded meadow desiccation and nest predation are top conservation concerns for the species.

Threats

Breeding populations of willow flycatchers in the Sierra Nevada are so small and vulnerable that any disturbance could be significant. The following are a few key areas of concern:

Meadow Desiccation: Meadows can become dried out when gullies are created following grazing, road building, timber harvest, mining, water diversion and recreation. When meadow hydrology is altered so that once-standing water drains quickly out a meadow and leaving soils dry, then a greater number of nest predators gain access to willow flycatcher nests (Green et al. 2003; Cocimano et al. 2011). Meadow desiccation also leads to reductions in meadow habitat quantity and quality by decreasing willow foliar density and increasing conifer encroachment into meadows (Ibid). It also decreases prey availability for breeding birds, and increases grazing pressure on willow shrubs (Green et al. 2003).
Nest predation: Nest predation is strongly associated with both meadow desiccation, reductions in willow foliar density, and proximity to even a single conifer tree (Green et al. 2003). Predation causes more nest failure than parasitism (Heath et al. 2010) and reduces willow flycatcher fecundity (Mathewson et al. 2010). It a factor in flycatcher decline, one that land managers have some control over, but is not the primary cause of decline (personal communication H. Bombay-Loffland, November 2012).

Nest Parasitism: Rates of nest parasitism in the Sierra Nevada are between 8-47%. Cowbird presence is strongly associated with pack stations and livestock (Borgmann and Morrison 2010). Nest parasitism is significantly greater near pack stations (Ibid). Grain spillage from pack stations and bird feeders on USFS lands may provide substantial food supplement to cowbirds in the Sierra Nevada (Green et al. 2003). Willow flycatchers have responded positively to cowbird removal in the South Fork Kern River area (Valentine et al. 1988).

Grazing: The critical status of the willow flycatcher warrants reducing or excluding livestock from montane meadows and riparian habitat, particularly where there are known flycatcher territories, unless new research can show it has no detrimental effects on the flycatcher and other species.

The 2004 Sierra Nevada Forest Plan Amendment asserted that grazing does not affect willow flycatcher declines, however, subsequent peer review by willow flycatcher experts found this assertion to be “circumstantial” and “based on inference” (Green et al. 2003). Scientists have looked back over hundreds of years of pollen records, finding that gully erosion and loss of willow cover in meadows occur for the first time only after livestock is introduced to the Sierra Nevada (Ibid). Grazing reduces foliage density at the same height willow flycatchers use for nesting (Flett and Sanders 1987), which in turn makes nests more vulnerable to predation (Cain et al. 2003; Cain et al. 2006; Mathewson 2010).

Cattle have also been repeatedly observed trampling potential willow flycatcher habitat and their nests in the Sierra Nevada (Stafford and Valentine 1985; Valentine et al.1988). Preference for edges of willow shrubs also makes nests more vulnerable to trampling by cattle (Valentine et al. 1988; Green et al. 2003). Indeed, 53% of nests were trampled by cows over the course of one five-year study (Valentine et al. 1988). Losses would have been greater in this study, but researchers chased off cows and repaired fences when possible. Willow flycatcher nest vulnerability increases over the course of the summer as cows concentrate more in wet riparian areas and willows seeking alternate forage and water (Valentine 1987; Valentine et al. 1988; Green et al. 2003).

There is also strong statistical evidence that grazing retards willow flycatcher recovery in Colorado (Green et al. 2003) and Oregon (Taylor and Littlefield 1986). Grazing livestock in high elevation meadows is contrary to recovery objectives for willow flycatcher and for meadows themselves.

Roads: As discussed in the travel management section of this conservation strategy, there is an overabundance of roads (over 47,000 miles) in California’s National Forests that undermine forests’ capacity to provide clean water and valuable wildlife habitat by degrading hydrologic function and soil quality. Roads located in the same watershed as important meadows can cause significant damage and should be restored during recovery of willow flycatcher habitat.

Water Diversion: California has lost or converted more riparian land than any other habitat type in the state. Between 1848 and 1979 over 88% of wetlands (upwards of 820,000 acres) were lost (RHJV 2000) and E. t. adastus was extirpated from California’s Central Valley (Harris et al. 1987). Likewise, willow and other riparian shrubs have been eradicated on the Owens River, Lee Vining and Rush Creeks because of the Los Angeles aqueduct, and are making modest recoveries as water is allowed back in the watershed. Water diversions continue to threaten dense riparian shrubs in the Sierra Nevada as new proposals are considered.
Recreation: A number of recreational activities can contribute to erosion and gulley formation including motorized vehicles, mountain bikes, livestock, and camping. All of these activities, as well as day use activities such as hiking and birding, can attract predators to nesting habitat and can leave behind garbage that attracts nest predators like mice, jays and squirrels.

Mining: To the extent that mining contributes to erosion and vulnerability of riparian and meadow soils, it also threatens willow flycatcher habitat.

Desired Condition

- Willow flycatcher populations are stable or increasing in the Sierra Nevada.
- Historic sites are reoccupied.
- Meadows remain wet throughout the willow flycatcher breeding period.
- Wet meadow habitat is:
  - resilient to climate change, and
  - protected from activities that compromise hydrologic function, and
  - restored where lost to erosion and other habitat degradation.
- Nest predation and parasitism rates are reduced to sustainable levels.

Objectives

- Protect existing meadow sites from habitat loss (ie. hydroelectric projects, mechanical activity, development, gullies, or grazing) (Harris et al. 1987).
- Secure source populations and habitat at Perazzo meadow.
- Allow mechanical activity in potential or occupied habitat only when it is conducive to willow flycatcher recovery.
- Restore nesting habitat in historic and degraded meadows. Monitor restoration success with habitat requisites (Green et al. 2003).
- Actively plant willow in restored meadows to accelerate establishment (Burnett 2009).
- Prioritize restoration efforts starting with meadows within dispersal distance of occupied meadows (Green et al. 2003).
- Willow flycatcher conservation planning and habitat protection should recognize that an unoccupied site could be reoccupied (Harris et al. 1987).
- Grazing in meadows should be stopped in areas where it is contributing to willow foliage reduction, soil drying, or erosion (Harris et al. 1987).
- Implement a willow flycatcher monitoring program investigating occupancy, fecundity, predation, and population status (Green et al. 2003).
- Investigate soil characteristics and livestock impacts on willow foliage density, soil wetness, and erosion (Green et al. 2003).
- Lessen the influence of cowbird parasitism on willow flycatcher by reducing cowbird numbers through limiting pack stations, residential areas, recreational areas and livestock grazing in willow flycatcher range and in suitable breeding areas regardless of occupancy status (Green et al. 2003).
- Conduct cowbird ecology studies that investigate the influence of dispersed and developed recreation effects, cowbird use and movements relative to livestock concentrations, the use by cowbirds of harvested sites and other factors related to cowbird abundance and behavior (Green et al. 2003).
**Conservation Measures**

- Conduct willow flycatcher surveys in suitable habitat every five years to determine status and habitat condition (Green et al. 2003).
- Prepare monitoring plans for areas supporting willow flycatcher and determine site-specific management actions that support willow flycatcher population and habitat recruitment. Implement within two years of forest plan adoption (Flett and Sanders 1987).
- Review meadows on each forest with existing, historic, or potential willow flycatcher habitat. Prioritize meadow restoration according to objectives above.
- Redesign roads and stream crossings within five miles of degraded habitat during meadow restoration and project planning, prohibit new roads in flycatcher habitat (Green et al. 2003).
- Modify livestock permits to eliminate grazing in suitable habitat within five miles of meadow and riparian ecosystems occupied by willow flycatchers (Green et al. 2003).
- Fence stream and meadow areas to prevent the entry of cattle on sensitive lands.
- Prohibit mechanical activity in potential or occupied meadows unless it is related to meadow restoration.
- Keep new developments that attract cowbirds and other nest predators, such as pack stations and campgrounds, away from riparian areas to minimize the impacts of the cowbirds on willow flycatchers.

Table A-14. Land allocations specific to willow flycatcher conservation.

<table>
<thead>
<tr>
<th>Land Allocation</th>
<th>Definition</th>
<th>Management Objective</th>
</tr>
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<tbody>
<tr>
<td>Willow Flycatcher: Occupied and Emphasis (WF)</td>
<td><strong>Occupied habitats</strong> are meadows or riparian sites with documented willow flycatcher. <strong>Emphasis habitat</strong> are defined as meadows larger than 15 acres that have standing water on June 1 and a deciduous shrub component.</td>
<td>Provide habitat conditions to support successful reproduction and persistence. Limit human uses in areas not currently in excellent condition. Maintain hydrologic function of meadow system.</td>
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**Other Recommendations**

Pursue acquisition or conservation easements on private parcels that include existing or potential habitat for willow flycatcher.

**References**


