An Updated Petition to list the California spotted owl (*Strix occidentalis occidentalis*) as a threatened or endangered species

Center for Biological Diversity

Sierra Nevada Forest Protection Campaign

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Ms. Gale Norton
Secretary of the Interior
Office of the Secretary
Department of the Interior
18th and "C" Street, N.W.
Washington, D.C. 20240

The Center for Biological Diversity, Sierra Nevada Forest Protection Campaign, and Noah Greenwald hereby formally repetition to list the California spotted owl *(Strix occidentalis occidentalis)* as threatened or endangered pursuant to the Endangered Species Act, 16 U.S.C. 1531 et seq. (hereafter referred to as "ESA"). This petition is filed under 5 U.S.C. 553(e) and 50 CFR 424.14 (1990), which grants interested parties the right to petition for issue of a rule from the Assistant Secretary of the Interior.

Petitioners also request that Critical Habitat be designated concurrent with the listing, as required by 16 U.S.C. § 1533(b)(6)(C) and 50 CFR 424.12, and pursuant to the Administrative Procedures Act (5 U.S.C. 553).

Petitioners understand that this petition action sets in motion a specific process placing definite response requirements on the U.S. Fish and Wildlife Service and very specific time constraints upon those responses. See 16 U.S.C. § 1533(b).

This is an updated version of a petition to protect the California spotted owl (*Strix occidentalis occidentalis*) as a threatened or endangered species that was submitted April, 2000. In response to the original petition, the U.S. Fish and Wildlife Service determined February 12, 2003 that the California spotted owl does not warrant listing. This decision was based primarily on protections provided by the Sierra Nevada Framework (USFS 2001). In making this decision, the agency recognized that the Forest Service was in the process of revising management direction developed in the Framework (referred to as the SNFPA), stating:

> "Subsequent to the establishment of management direction by the Record of Decision of the SNFPA, Region 5 of the Forest Service has undertaken two efforts that may result in changes in the anticipated impacts of the SNFPA. The first is a management review of the SNFPA (USFS 2002b), and the second is planning for implementation of an Administrative Study on the Lassen and Plumas National Forests that would evaluate the effects of extensive fuels treatments on the California spotted owl (67 FR 72136). As of yet, neither of these efforts have formally established management direction, so their potential effects are uncertain and subject to change before implementation. Therefore, their potential effects are not included in the assessment of threats to the California spotted owl under this 12-month finding. However, because the outcome of each of these efforts could substantially affect California spotted owls, we will monitor the development of management direction, offer scientific assistance, and review the effects at a later date, if necessary."

In January, 2004, the U.S. Forest Service amended the Sierra Nevada Framework substantially weakening protections for the California spotted owl and old-forests in general and allowing the Quincy Library Group Pilot Project to be fully implemented (USFS 2004). Because these changes directly

implicate two of the statutory criteria – the adequacy of existing regulatory mechanisms and present or threatened destruction, modification or curtailment of habitat or range – in a way that significantly undermines the Fish and Wildlife Service's previous determination not to list the owl, we are submitting this updated version of our original petition.

Petitioners

Center for Biological Diversity is a non-profit public interest organization dedicated to protecting the diverse life forms of western North America. It has offices in New Mexico, Arizona, and California

Sierra Nevada Forest Protection Campaign is a coalition of grassroots, regional, and national conservation groups dedicated to the protection of the Sierra Nevada's magnificent national forests.

Natural Resources Defense Council is a national nonprofit organization dedicated to protecting the world's natural resources and ensuring a safe and healthy environment for all people. NRDC has played a lead role in protecting the forests and wildlife of California's Sierra Nevada on behalf of its 400,000 members, many who use and enjoy these forests for recreation and other purposes.

Defenders of Wildlife is dedicated to the protection of all native wild animals and plants in their natural communities. We focus our programs on what scientists consider two of the most serious environmental threats to the planet: the accelerating rate of extinction of species and the associated loss of biological diversity, and habitat alteration and destruction.

The Wilderness Society works to protect America's wilderness and to develop a nation-wide network of wild lands through public education, scientific analysis and advocacy.

Sierra Club is a nonprofit organization whose mission is to explore, enjoy and protect the wild places of the earth; to practice and promote the responsible use of the earth□s ecosystems and resources; to educate and enlist humanity to protect and restore the quality of the natural and human environment; and to use all lawful means to carry out these objectives.

Friends of the River is dedicated to the protection, preservation, and restoration of California's free flowing rivers and watersheds. Friends of the River has more than 7,000 members, many of whom recreate and enjoy the rivers and streams of the Sierra Nevada national forests.

John Muir Project of Earth Island Institute is dedicated to ending the timber sales program on all federal public lands nationwide through public education, litigation, and organizing for the passage of HR 1396, the National Forest Protection and Restoration Act.

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Executive Summary

The three subspecies of the spotted owl—northern, California and Mexican—possess nearly every characteristic of a species at risk of extinction. They are large-bodied predators with slow reproduction and specialized habitat requirements. Because of threats to their habitat, primarily from logging, both the northern and Mexican subspecies are listed as threatened under the Endangered Species Act (ESA). Despite similar threats, the California spotted owl has not received Federal protection. An abundance of information now indicates such protection is warranted. Forests of the Sierra Nevada have been severely altered by over a century of logging, resulting in drastic declines in owl habitat. Demography studies of the California spotted owl suggest the owl is declining. Though loss and fragmentation of habitat, climate, low prey density or a combination of all of these are all possible causes for these declines, compelling evidence indicates that habitat loss due to logging plays a significant role in declines. Finally, existing regulations on both federal and private lands are inadequate to protect owl habitat and populations. Thus the California spotted owl meets several criteria for determination as a threatened or endangered species under the Endangered Species Act:

A. The present or threatened destruction, modification, or curtailment of the owl's habitat or range:

- Over a century of logging in the Sierra Nevada has resulted in the loss and reduction of several key attributes of owl habitat from a majority of the landscape, including large trees, snags, downed logs, high total canopy cover, and multi-layered canopies.

- Logging has resulted in extensive habitat fragmentation. Beardsley et al. (1999) and Franklin and Fites-Kaufmann (1996) estimate old growth has declined by approximately 80% in the Sierra Nevada with large, contiguous blocks primarily limited to national parks.

- Logging under the 2004 revised Framework and the Herger Feinstein Quincy Library Group Pilot Project threatens to further degrade and destroy California spotted owl habitat.

- On private lands, over 12,000 logging operations occurred near owl sites between 1990-1999.

- Differences in the status of owls in Sequoia/Kings Canyon National Park, where owl populations are nearly stable, and the Sierra National Forest, where owls are likely declining, strongly suggests that habitat loss due to logging is a determining factor in owl declines.

- Urban development has resulted in significant loss of habitat, particularly at low elevations in the Sierra Nevada and southern California.

- Other human actions, including livestock grazing, mining, recreation and road construction, have contributed to the past and present loss and degradation of owl habitat.

B. Disease or predation.

- The spotted owl is subject to predation by great horned owls, goshawks and red tailed hawks. Because great horned owls and red-tailed hawks occur in more open areas than spotted owls, logging may increase their abundance and the likelihood that they will take spotted owls.

- The recent spread of West Nile Virus to California potentially threatens the California spotted owl, which is known to be susceptible to the disease.

C. Other natural or human caused factors:

- Spreading from the north, the barred owl has occupied the entire range of the northern spotted owl in just 40 years and has spread into the range of the California spotted owl to as far south as the Sequoia National Forest within the last 10 years. Larger and more aggressive, the barred owl is known to displace spotted owls. Barred owls also hybridize with spotted owls.

- Logging, livestock grazing and fire suppression have altered fire regimes over much of the Sierra Nevada by eliminating the conditions that allowed frequent fires to burn at low intensities. Resulting changes in forest structure and build-up of fuels have put some stands at increased risk of stand-replacing fire, though to date this risk has not been quantified.

- Short-term climate fluctuations, which have been correlated with lowered fecundity (Franklin et al. in press and Verner 1999), may be exacerbating owl population declines.

D. Inadequacy of existing regulations to protect the owl and its habitat

- Continued loss and degradation of habitat relates directly to inadequacies in existing regulations, including the revised Sierra Nevada Framework and the California State Forest Practices Code.

- Protection for large trees, high canopy closure, multiple canopy layers and snags and downed wood in the 2004 Framework fall short of the owl's documented habitat requirements, allowing for continued loss of nesting, roosting and foraging habitat.

- The 2004 Framework provides no limits on the proportion of the landscape that can be degraded, allowing for increased habitat fragmentation—a major threat to the long-term viability of the owl.

- On private lands, California's Forest Practices Code provides almost no specific protections for the California spotted owl or its habitat.

I. Species Description

A. Non technical

The spotted owl is a medium sized owl, lacking ear-tufts. Unlike most owls, which have yellow eyes, it has dark brown eyes. Coloring is mottled brown and white. The back is brown with white spots, contrasting lighter underparts also with white spots. Facial disk is pale brown, surrounded by a dark brown ring of feathers. Light colored "eyebrows" and "whiskers" form a distinctive X between the eyes. The bill is horn colored to light yellow. Claws are dark brown to black. Legs and toes are covered by buff colored feathers. Size 16-19 inches; wingspan 42-45 inches. Sexes mostly similar.

B. Technical

Average wing length, male 12.6 inches, female 12.9 inches; tail, males 8.5 inches, female 8.9 inches (in Johnsgard 1988); average weight of 46 central Sierra males 19.6 ounces, of 48 central Sierra females 22.2 ounces (Verner et al. 1992a); upperparts brown with irregular white spots, which are larger and more transverse on exterior scapulars and some wing coverts; secondaries with six or seven light brown bands; outer parts of primaries with lighter spots; tail barred with about ten narrow light brown bands; postocular and auricular regions of facial disk light brown, concentrically barred with darker brown; feathers bordering facial disk dark brown; superciliary "eyebrows" and lores white; feathers above and beside eyes dark sooty brown; middle throat pale brown; lower throat dull white; underparts buff with large white spots; legs buff, spotted brown; bill horn colored to dull yellow; claws brown to black (Johnsgard 1988, Gutiérrez et al. 1995). Sexes appear similar; females heavier and generally larger (Blakesley et al. 1990). Late-year juveniles distinguished by clear, white pointed rectrices (Forsman 1981, Moen et al. 1991). Coloration is progressively lighter brown and spots are progressively larger from northern to California to Mexican spotted owl (Gutiérrez et. al. 1995).

C. Taxonomy

There are three recognized subspecies of the spotted owl (*Strix occidentalis*) (AOU 1957), including the California spotted owl (*S.o. occidentalis*) (Xantus 1859), northern spotted owl (*S.o. caurina*) (Merriam 1898), and Mexican spotted owl (*S.o. lucida)* (Nelson 1903). The northern subspecies is found from southwestern British Columbia to central California in the coast ranges, intersecting with the California spotted owl's range in the southern Cascades at the Pit River. The California subspecies ranges from the southern Cascades through the Sierra Nevada and southern California ranges. The Mexican spotted owl is disjunct from the two other subspecies and is found from southern Utah and Colorado, through Arizona, New Mexico and western Texas, and south through the Mexican Plateau (Gutiérrez et al. 1995).

Barrowclough et al. (1999), using mitochondrial DNA sequencing to assess gene flow, genetic structure and biogeographic relationships within and among the three subspecies of spotted owl, found that they are phylogenetic species that have been reproductively isolated for "at least tens of thousands of years." They also found evidence of recent gene flow between the California and northern subspecies, but hypothesized that such events are "uncommon." Interestingly, they found that the northern subspecies first split from the combined Mexican and Californian spotted owls, which later split into two separate subspecies. Lastly, they found that the California spotted owl had an order of magnitude lower nucleotide diversity than either the Mexican or northern spotted owls and speculated that this was either because of a past population bottleneck or a mutant haplotype had swept through the population. It is unknown at this time whether

reduced diversity in the California subspecies affects its conservation status.

Haig et al. (2001) used random amplified polymorphic DNA (RAPD) to examine within and among subspecies population structure, finding a lack of clear differentiation between northern and California spotted owls and identifying Mexican spotted owls as a distinct clade. Based on these findings, Haig et al. (2001) recommend recognizing the Mexican spotted owl as an "evolutionary significant unit," and the northern and Mexican spotted owls as "two overlapping management units."

Based on conflicting conclusions between Barrowclough et al. (1999) and Haig et al. (2001), USFWS (2003) decided to rely on AOU (1957), stating:

> "Currently available, published genetic data (i.e., mtDNA and RAPDs) apparently lead to different conclusions regarding subspecific distinctions in spotted owls. Therefore, for the purposes of this finding, we adopt the taxonomy accepted by the American Ornithological Union (AOU 1957), which recognizes the California spotted owl as a distinct subspecies (Strix occidentalis occidentalis)."

Since U.S. Fish and Wildlife Service issued their finding on the California spotted owl,
Haig et al. (In press) analyzed mitochondrial DNA to "define relationships among subspecies and quantify variation within and among regional and local populations." Working with a larger sample size han Barrowclough et al. (1999), these new analyses found significant differences between northern spotted owls and the other subspecies, but only "weak support for the traditional Mexican and California spotted owl relationship at the subspecies level." Haig et al. (In press) found unique haplotypes in both California and Mexican spotted owls, but the amount of overlap was above recognized standards for subspecies designation. Despite this finding, Haig et al. recommend managing Mexican and California spotted owls separately "because of current isolation between groups." Mitochondrial DNA provides only one measure of genetic separation between the Mexican and California subspecies and is used to look at evolutionary (historic) differences among groups. Further work using microsatellites (which delineate more recent events) is being planned and may indicate continued recognition of the two subspecies (S. Haig, personal communication). In addition, further genetic studies of the contact zone between Mexican and California spotted owls may reveal additional differences between the two groups similar to findings for the northern and California subspecies (S. Haig, personal communication).

In sum, genetic studies continue to improve our understanding of spotted owl population structure, but have not definitively determined that there should be a revision of the currently accepted taxonomy. Moreover, the AOU continues to recognize three subspecies of spotted owl. Thus, the best available science dictates that the U.S. Fish and Wildlife Service continue to recognize all three subspecies of spotted owl.

II. Natural History

A. Diet

The diet of the California spotted owl is highly varied, including dusky-footed woodrats (*Neotoma fuscipes*), northern flying squirrels (*Glaucomys sabrinus*), deer mice (*Peromyscus maniculatus*), brush mice (*Peromyscus boylii*), California mice (*Peromyscus californicus*), pocket gophers (*Thomomys bottae*), bats (*Myotis sp.* and *Lasirus cinereus*), crickets and other insects, amphibians, screech owls (*Otus asio*), and Steller's jays (*Cyanocitta stellari*) (Barrows 1980, Hedlund 1996, Marshall 1942, Smith et. al. 1999, Thrailkill and Bias 1989). In terms of number of individuals taken and proportional biomass of selected prey, however, the California spotted owl is a conservative forager,

primarily selecting relatively few prey species, probably based on size and ease of capture; others are taken only opportunistically (Hedlund 1996, Thrailkill and Bias 1989). Hedlund (1996), for example, documented that 80% of all pellets in the San Gabriel Mountains, southern California contained remains of dusky-footed woodrats. Trapping, however, revealed that woodrats only made up 30% of small mammal fauna, less than the California mouse (Hedlund 1996). Thus, woodrats were preferentially selected over their abundance. This is probably because of their large size, which increases foraging efficiency (Hedlund 1996, Thrailkill and Bias 1989, Smith et al. 1999). Thrailkill and Bias (1989) demonstrated breeding spotted owls select larger prey than non-breeding owls, indicating availability of large prey may affect breeding success. In support of this conclusion, Smith et. al. (1999) documented that successful nesting spotted owls consumed a greater percent biomass of woodrats than either unsuccessful or non-nesting spotted owls in southern California.

Diets differ between spotted owls at mid-elevations in the Sierra, and the Sierran foothills and southern California. In the former, flying squirrels are the primary component of owl diets, whereas in the latter dusky-footed woodrats are the primary prey and flying squirrels are only a minor constituent of owl diets (Hedlund 1996, Thrailkill and Bias 1989, Verner et al. 1992).

B. Foraging

Spotted owls capture prey by perching on elevated tree limbs or other substrate and silently pouncing on prey (Forsman 1976). They also are adept at "hawking"—capturing birds and insects on the wing (Verner et al. 1992). Spotted owls hunt both by sight and sound and are able to capture prey on the ground, on shrubs or on trees (Verner et al. 1992). If needed, they will move to a better perch before pouncing and sometimes will hop across the ground in pursuit of prey. Because of their use of perches and because nearly all their prey items are found in forested habitats, spotted owls rarely forage in open areas (Barrows 1980, Call et al. 1992).

Spotted owls are primarily night foragers. Forsman et al. (1984) found northern spotted owls on average left their roosts 14 minutes after sunset and stopped foraging 21 minutes before sunrise. During the day, spotted owls spend most of their time roosting, but are known to take prey opportunistically. Laymon (1991) observed California spotted owls in the western Sierra Nevada regularly foraging during the day when they were feeding young, but not otherwise.

C. Vocalizations

The spotted owl uses a variety of calls, including various hoots, barks and whistles. Forsman et al. (1984) defined 13 primary types of vocalizations. The most common of these is the "four-note location call", which is used in territorial disputes and for location between paired owls. It is characterized by a single hoot followed by a short pause, two closely spaced hoots, another short pause, and then a final hoot. Forsman et al. (1984) represented this phonetically as: hoo - - - hoo-hoo - - - - hooo. Others include a "bark series" characterized by three-seven loud barking notes at the rate of two-three notes per second, used mostly by females during territorial disputes; "series location calls," which is a sequence of 7-15 hoots used mostly during territorial disputes; "contact call," which is a "hollow whistled note ending in an upward inflection" used mostly by females to alert the male or young of her location for delivery of food or copulation, and "juvenile begging call," which is a high pitched whistle used to indicate hunger (Forsman et al. 1984). Juveniles develop most adult calls in the fall or winter of their first year (Ibid.). Females generally have a higher pitched call, allowing for identification of sex (Blakesley et al. 1990).

D. Reproduction

Spotted owls are monogamous with both members of a pair remaining in the same home range throughout the year, though often not roosting together during the non-breeding season (Forsman et. al. 1984, Verner et al. 1992). The breeding season begins in mid-February and lasts until as late as early October with considerable variation depending on elevation and latitude (Verner et. al. 1992). Birds in the foothills of both southern California and the Sierra Nevada, for example, are thought to begin breeding about two weeks earlier than birds in mixed conifer forests of their respective ranges and birds in southern California mixed conifer forests are thought to begin breeding about four days before birds in Sierra Nevada mixed conifer forests (Verner et. al. 1992). Pairs begin regularly roosting together about two-three weeks before laying. During this time, the male begins feeding the female and they engage in mutual preening and copulation (Verner et. al. 1992). Once egg laying begins (one-six days), continuing through incubation (28-32 days), and until the nestlings are two to three weeks old, the female receives all of her food from the male. Peak egg laying is from about April 7 to 21 in the San Bernardino Mountains and from about April 11 to 25 in the Sierra Nevada (Verner et al. 1992). Clutch sizes of the spotted owl are small with most containing one or two eggs, infrequently three and very rarely four eggs (LaHaye 1997, Verner et al. 1992). During incubation, female owls develop a distinctive brood patch, where feathers are absent and the skin is thickened. All incubation is done by the female (Johnsgard 1988). Nestlings are semialtricial and remain in the nest for 34-36 days (Forsman et al. 1984). For the first week following fledging, the young are clumsy fliers and thus are often restricted to a single perch or even the ground for several days at a time. After the first week, they can generally fly between trees. The parents continue to feed the fledglings until late September or early October (Verner et al. 1992).

Rather than constructing their own nests, spotted owls use tree cavities, mistletoe brooms, depressions in broken-top trees or snags, or platform nests constructed by other species, such as goshawks, ravens or tree squirrels (Gutiérrez et al. 1992, Gutiérrez et al. 1995). Platform nests are more common in southern California, whereas cavities are more common in the Sierra Nevada (Gutiérrez et al. 1992, Gutiérrez et al. 1995). Similarly, snags are more often used in southern California and the southern Sierra Nevada than in the northern Sierra Nevada, but still less than live trees. Nests occurred in a variety of species, including ten species of conifer and seven species of hardwood. Use of hardwoods for nesting primarily occurs in riparian hardwood forests (Gutiérrez et al. 1992). Nests are almost universally found in larger trees. Gutiérrez et al. (1992) compiled data from 1986-1991 on all National Forests in the range of the California spotted owl and found mean nest trees of approximately 45" dbh in Sierra Nevada mixed conifer, 37" dbh in southern California mixed conifer and 29.5" dbh in riparian hardwood forests. Nest trees are also typically old, frequently ranging from 200-350+ years in age (Gutiérrez et al. 1992, North et al. In press, LaHaye and Gutiérrez 1999). This is probably because old trees are more likely to have large cavities, broken tops or other deformities used for nesting by the spotted owl. A century and a half of logging in the Sierra Nevada, focusing on large trees that take several centuries to grow, has drastically reduced the quantity and distribution of trees used by the owl for nesting (Verner et al. 1992). Gutiérrez et al. (1992) state: "it is reasonable to hypothesize large-diameter trees as a current or potentially limiting factor sometime in the future."

E. The range and distribution of the California spotted owl

The range of the California spotted owl is the smallest of the three subspecies, encompassing approximately one quarter or less the area of the northern or Mexican spotted owl's range

(Gutiérrez and Harrison 1996). In the Sierra Nevada, the spotted owl's historic range was probably continuous. Today, it remains largely so, but because of a combination of natural and anthropogenic habitat fragmentation has several discontinuities (Beck and Gould 1992, see below). The spotted owl's range in southern California was historically discontinuous. However, this discontinuity likely has been heightened by loss of low elevation dispersal habitat because of development and other factors (Noon and McKelvey 1992).

Sierra Nevada. The California spotted owl's range in the Sierra Nevada includes the entire western side of the Sierra Nevada from the Pit River in the southern Cascades south to Tehachapi Pass (Gould 1977, Verner et al. 1992). At the Pit River, the California spotted owl's range connects with the range of the northern spotted owl, where the two subspecies probably interbreed (Barrowclough et al. 1999, Verner et al. 1992). At the southern end of the range, it is likely that birds historically crossed Tehachapi Pass, allowing interchange between the two population groups of California spotted owls. A small number of territories have also been found in the eastern Sierra Nevada in both red fir and eastside pine forests.

In the Sierra Nevada, the California spotted owl occurs in mixed conifer, red fir, ponderosa pine and foothill riparian forests. Verner et al. (1992) calculated that 81.5% of territories were in mixed conifer, 9.7% in red fir, 6.7% in pine-oak, 1.6% in foothill riparian hardwood and .5% in eastside pine. Sierra Nevada mixed conifer not only harbors the majority of birds within the mountain range, but also rangewide with 62.4% of all territories known in 1992 (Verner et al. 1992). Though only slightly less than 7% of all territories are found in pine-oak, this habitat type also provides winter habitat for an unknown number of owls. Laymon (1988) and Verner et al. (1991) found that owls migrated during the winter from mixed conifer forests to low elevation (<3,900 ft.) pine-oak woodlands, comprised of either ponderosa or gray pine. Conversely, Call et al. (1992) did not observe migration in their study of owls on the Tahoe National Forest, indicating only a portion of California spotted owls migrate.

Sierran mixed conifer forests occupy a mid elevation belt on the westside of the Sierra Nevada, roughly 10-70, but mostly less than 30, miles wide and approximately 400 miles long (Langley 1996). In total, Sierran mixed conifer forests occupy approximately 6,546 km^2 (Davis and Stoms 1996). Primary tree species in this zone include Douglas-fir, sugar pine, ponderosa pine, white fir, incense cedar, black oak and red fir (Verner et al. 1992). Davis and Stoms (1996) estimate that Sierran mixed conifer forests are approximately 68% publicly and 32% privately owned. Verner et al. (1992) state "most of the best forest-growing lands in the Sierra Nevada are owned by commercial timber companies in the mixed-conifer zone," indicating private lands may have historically played a greater role in supporting California spotted owls in mixed conifer forests than they do today (see below). The narrowness of the owl's prime habitat causes it to be highly subject to discontinuity from habitat fragmentation and indeed there are currently several discontinuities in its distribution (see below).

Red fir forests occur directly above mixed conifer forests, occupying roughly 4,550 km^2 (Davis and Stoms 1996). Though red fir is the predominant tree species, white fir is common in stands at lower elevations and lodgepole pine and quaking aspen are common in stands at higher elevations (Verner et al. 1992). Over 90% of all red fir forests in the Sierra Nevada are publicly owned and nearly 25% are managed by the National Park Service (Davis and Stoms 1996).

Westside ponderosa pine forests occur below the mixed conifer zone in the Sierra Nevada and occupy roughly 4,402 km^2 (Davis and Stoms 1996). Ponderosa pine is the dominant overstory species, mixing with incense cedar

Table 1, numbers and percent in parentheses of reliable territories related to ownership and management agency. Data taken from US Fish and Wildlife Service 2003 (p. 7484).

	USFS	Private	NPS	BLM	State	Native	Total
Sierra Nevada	1399 (75)	314 (17)	129 (7)	14 (.8)	8 (.3)	1	1865
S. California	329 (75)	95 (22)	0	2 (.5)	6 (1.4)	4 (.9)	439

and white fir at higher elevations (Verner et al. 1992). Several species of oak are common under- or mid-story species. Approximately 65% is publicly owned (Davis and Stoms 1996). Along with eastside ponderosa pine forests, this is one of the most heavily logged forest types (Franklin and Fites-Kaufmann 1996).

Riparian hardwood forests occupy a relatively small portion of the landscape in the foothills of the Sierra Nevada (Davis and Stoms 1996). Primary tree species include cottonwood, sycamore, interior live oak, Oregon ash and buckeye (Verner et al. 1992). The majority of these forests are privately owned (>70%)(Davis and Stoms 1996) and many areas are threatened with development or have already been developed.

Eastside pine forests occupy roughly 1,614 km^2 (Davis and Stoms 1996) east of the Sierra Nevada crest. Ponderosa and Jeffrey pine are Stoms 1996, Verner et al. 1992), however, it is likely that historically a larger percentage of territories occurred on these lands. This potential shift in distribution likely reflects the degree to which habitat on private lands has been degraded and fragmented.

Southern California. The California spotted owl occurs in all major mountain ranges of southern California, including the San Bernardino, San Gabriel, Tehachapi, Santa Lucia, Santa Ana, Cuyamaca/Laguna, Liebre/Sawmill Mountain, Mount San Jacinto, Palomar Mountain and the Los Padres Ranges (Noon and McKelvey 1992). These ranges form isolated habitat islands, surrounded primarily by low elevation desert scrub and chaparral, which is unsuitable for the owl (Noon and McKelvey 1992). Habitat islands vary in size and the major tree species. Eighty percent of eastside ponderosa pine forests are publicly owned (Davis and Stoms 1996). Though historical occupancy of eastside ponderosa pine is unknown, the current limited distribution of owls is likely at least in part due to heavy logging of this forest type dating back to the late nineteenth century and continuing to the present. Franklin and Fites-Kaufmann (1996), for example, found that 78% of eastside pine forests lacked significant traits of late successional forests.

Of the 1865 owl sites known in the Sierra Nevada, the majority (75%) are found on National Forest Lands with a lesser amount found on private lands (17%), National Parks (7%), Bureau of Land Management lands (.8%), state lands (.3%) and Native American lands (one territory) (Table 1). Given that approximately 30-40% of potential, suitable habitat is found on private lands (Davis and proximity to other ranges and thus differ widely in the number of owl sites they support (e.g. MacArthur and Wilson 1967). For example, the Santa Ana Mountains, which are fairly small and 30-40 miles from other mountain ranges, only supported two owl sites in 1992 (Noon and McKelvey 1992). Whereas, the San Bernardino Mountains, one of the larger ranges and within 12 miles of two other ranges, have a total of 132 sites (Gutiérrez et al. 1999). Noon and McKelvey (1992) characterized the distribution of the California spotted owl in southern California as:

Table 2. Size of trees in stands selected for nesting, roosting and foraging by California spotted owls.

Study	size of trees: nesting and roosting (dbh inches)	size of trees: foraging (dbh inches)
Gould 1977	>33”*	
Bias and Gutiérrez 1992	>24”	
Moen and Gutiérrez 1997	>24”	
LaHaye et al. 1997	>20”	
Laymon 1988	>24”	>24”
Call 1990		>20”
Zabel et al. 1992		>21”**

*Both California and northern spotted owls
**Both roosting and foraging locations

> “an insular population structure characterized by large (about 200 pair sites) to small (about 2-4 pair sites) localpopulations distributed among discrete mountain ranges. The distribution of habitat “islands” is discontinuous across the landscape, reflecting natural discontinuities in vegetation structure and composition, in topographic conditions and in the effects of extensive human-induced habitat disturbance and fragmentation.”

Isolation of southern California spotted owl populations is likely greater today than it was historically because of loss of low elevation habitats, such as riparian forests, that may have facilitated dispersal. Historically, California spotted owls were found in riparian canyons of San Diego, Riverside and Los Angeles Counties (Bandier 1892, Dawson 1923, Sechrist 1938, Heller 1893, Cole 1908, Payton and Nokes 1925, Payton 1909). For example, spotted owl eggs were collected in Fish Canyon in Los Angeles County, where a nest was found in a also been found in coast redwood/California-laurel forests (Verner et al. 1992). Live oak/bigcone Douglas-fir forests are dominated by coast and canyon live oak and bigcone Douglas-fir and occur in a narrow band at mid elevations. Riparian/hardwood forests occur in riparian canyons of the various ranges and are dominated by a variety of tree species, including coast and canyon live oak, cottonwood, sycamore, white alder and California laurel “hole in a rocky cliff” (Paytan and Nokes 1925), near Riverside, California, where a nest was located in a cottonwood tree (Heller 1893), and Fanita Ranch, San Diego, California, where a nest was found in a sycamore in a dense stand of live oaks (Sechrist 1938). Low elevation riparian forests in all likelihood formed a network that allowed dispersal between the various isolated mountain ranges (LaHaye personal communication). Presently, nearly this entire habitat has been lost to development, water consumption, dams and livestock grazing (GAO 1988). Additionally, many low elevation areas between mountain ranges occupied by spotted owls have been converted to urban areas possibly further reducing the likelihood of dispersal.

The owl primarily occurs in three vegetation community types in southern California, including live oak/bigcone Douglas-fir (40.8% of sites), riparian/hardwood (32.2% of sites) and mixed conifer (26.4% of sites) forests (Verner et al. 1992). A small number of owl sites have (Verner et al. 1992). Southern California mixed conifer forests are found at 6,000-9,000’ in elevation in the larger ranges and consist of ponderosa pine, white fir, Coulter pine, bigcone Douglas-fir, sugar pine and incense cedar. Verner et al. (1992) estimated that there are 573,000 acres of suitable habitat in southern California, mostly under Forest Service management (94%), but stated “we still cannot

characterize the full range of conditions that comprise suitable habitat there."

There are approximately 439 reliably documented owl locations in southern California. Of these, National Forest lands harbor the majority (75%), followed by private lands (22%), state lands (1.4%), Native American lands (.9%) and Bureau of Land Management lands (.5%). (US Fish and Wildlife Service 2003, p. 7584).

III. Habitat Requirements

Every study on the habitat use and requirements of the California spotted owl concludes that it is a habitat specialist, which selects stand characteristics associated with old growth or mature forests for nesting, roosting and foraging. These include large trees, high canopy closure, decadent stand traits, such as snags and broken tops, and at least a two-layered canopy (e.g. Bias and Gutiérrez 1992, Moen and Gutiérrez 1997, LaHaye et al. 1997, Gutiérrez et al. 1992). These results are consistent with findings for both the northern and Mexican spotted owls (e.g. Gutiérrez et al. 1998, LaHaye and Gutiérrez 1999, Peery et al. 1999). Below, we present the current evidence concerning habitat attributes required by the owl.

A. Large trees

Roosting and nesting requirements. Every study that has quantified the nesting and roosting characteristics of the California spotted owl has demonstrated significant selection for stands with trees larger than 20-24" dbh (Table 2). In the first of these studies, Gould (1977) described stand characteristics at 192 California and northern spotted owl territories throughout California. Of these 192 sites, 83% were dominated by trees larger than 33" dbh. More recently and in a study specific to the California spotted owl, Bias and Gutiérrez (1992) measured stand traits at eleven nest sites in the Central Sierra Nevada, in combined variable radius and .04 ha. plots, and found greater basal area of medium (12-24" dbh), mature (24-40" dbh) and old growth (>40" dbh) trees than found in random plots. Eight of the eleven nests were in stands with dominant trees >24" diameter at breast height (dbh), whereas the remaining three were in stands with dominant trees 12-24" dbh. All eleven nest stands, however, had one or more residual old growth trees. Similarly, Moen and Gutiérrez (1997), in a study of 25 owl "activity centers," found that nest stands contain significantly more and larger trees (>24")(P = .0033) and more residual old growth trees (>40") than random stands (P = .0018). Large trees are required by California spotted owls in the southern portion of their range, as well. In a study of 103 owl territories in the San Bernardino Mountains, LaHaye et al. (1997) documented that owls selected nesting stands, measured in variable radius plots, with significantly higher basal areas of conifer trees 20-30" and >30" dbh and hardwood trees 12-18" and >18" dbh than random stands ($p < .05$).

Results were nearly identical for roost sites. Moen and Gutiérrez (1997) documented that 97% of all roosts located had residual old growth trees (>40" dbh), including many that were found in stands the Forest Service had classed via remote sensing as mixed conifer, pole stage (12-24" dbh)[1]. Similarly, Laymon (1988), using data from 12 radio-marked birds, demonstrated that owls select roosting stands with significantly greater densities of trees >24" diameter in both summer and fall than in random plots. Indeed, summer roosts had 80% more large trees (>24") than random plots, leading Laymon to conclude: "thus, summer roost sites exhibited many more characteristics of dense, mature forest than did the forest in the home ranges at large."

[1] Despite the inability of remote sensing to identify stands with residual old growth trees characteristic of owl habitat, the Forest Service has continued to use remote sensing for determining management of spotted owl habitat. As a result, some owl habitat likely has been classified as non-owl habitat and received less protection.

Foraging requirements. Similar to nesting and roosting habitat, foraging owls select stands with large trees (Table 2). In a study of 12 radio-marked owls on the Eldorado National Forest, for example, Laymon (1988) documented that a majority of foraging locations were in stands with trees >24" dbh and that owls used stands with trees >24" dbh significantly more than expected based on their availability on the landscape, whereas stands with trees 11-24" dbh were used significantly less than expected based on availability. Similarly, in a study of seven radio marked owls on the Tahoe National Forest, Call (1990) found owls use clearcuts and other openings less than expected based on availability, stands with trees 11-20" dbh in proportion to their availability and stands with trees 20-35" dbh significantly more than expected based on availability. Finally, Irwin (2003) found that stands were more likely to be used by radio-marked owls with increasing densities of trees >26" dbh and less likely to be used with increasing numbers of trees <14" dbh. All three studies indicate owls select stands with large trees (>20" dbh) while foraging.

B. Canopy closure

Nesting and roosting requirements. All studies demonstrate that the California spotted owl selects stands with high canopy closure, generally ≥70%. Of eleven nest sites measured by Bias and Gutiérrez (1992), ten had canopy closure >70% and all had significantly higher canopy closure than found in randomly selected plots. In southern California, LaHaye et al. (1997) documented a mean canopy closure of 79.3% for nest stands compared to 52.4% for random plots. Canopy closure was also significantly higher at roost sites than random plots. Moen and Gutiérrez (1997) found 99% of all roosts had canopy closure >40%, failing, however, to specify how many were over 70%. Laymon (1988) documented 99% of all roosts had canopy closure between 60-100% in summer with a 26% higher mean than random plots. A majority of fall and winter roosts (73 and 66% respectively) also had canopy closure between 60-100%. Bias and Gutierrez (1992) found 29 of 29 roost sites had canopy closure >70%. Hunsaker et al. (2002) found that owls occupied sites significantly less when canopy closure in the activity center (represented as a 72 ha circle) was between 20-39% than when it was over 50% and concluded:

> "Our results corroborate the findings of Verner et al. (1992): that California spotted owls are habitat specialists and, for nesting, they select stands with relatively closed canopies (greater than 70%)."

Similarly, Blakesley et al. (In press) found that site occupancy was positively associated with the amount of nest area dominated by canopy cover >70%. Thus, evidence indicates California spotted owls require >70% canopy closure for nesting and roosting.

Foraging requirements. Studies demonstrate that California spotted owls selectively forage in stands with at least 50% canopy closure (Gutiérrez et al. 1992). Laymon (1988) documented that a majority of foraging locations had canopy closure between 60-100% and that stands with 60-100% canopy closure and trees 11-24" dbh were selected in greater proportion to their availability. In addition, owls selected stands with canopy closure between 40-59% and large trees, and avoided stands with 10-39% canopy closure regardless of tree size. Call (1990) in a study of radio-marked owls on the Tahoe National Forest documented a mean canopy closure of 91.8% at foraging sites, which was significantly different than random sites (mean canopy closure of 85.2%), and that stands with both 40-69% and >70% canopy closure were used in greater proportion than their availability. Verner et al. (1991) in a study of radio-marked owls in the Sierra National Forest and Sequoia/Kings Canyon National Parks found that owls use, including both foraging and roosting locations, stands with >70% canopy closure more than expected based on availability and stands with

canopy closure 40-69% were used in proportion to their availability, suggesting even higher levels of canopy closure are selected. Similarly, Call et al. (1992) documented that owl home ranges contained more stands with >70% canopy closure than available on the landscape and that stands with 40-69% canopy closure were found in proportion to their availability. Zabel et al. (1992) located more owls in stands with canopy closure >40% and these stands were used more than expected by the owls based on their availability on the landscape, whereas stands with <40% canopy cover were used less than expected. Unfortunately, Zabel et al. (1992) did not separate stands with >70% canopy closure from stands with 40-69% canopy closure for analysis of selection. More foraging and roosting locations documented by Zabel et al. (1992), however, were found in stands with >70% canopy closure on the Lassen National Forest and Sierra National Forest riparian oak study areas than in stands with canopy closure 40-69% and the mean proportion of locations in stands with >70% canopy closure was higher than the mean proportion of these stands within the home ranges on all of the three study areas (Table 3). Conversely, the mean proportion of locations in stands with canopy closure 40-69% was in most cases nearly equal to or less than the mean proportion of these stands in the home ranges (Table 3). Hunsaker et al. (2002) found a correlation between the proportion of the landscape with higher canopy cover values and owl occupancy and productivity, concluding:

> "From these correlations, one would conclude that the threshold between canopy cover values that contribute to or detract from occurrence and productivity is a value near 50%. Indeed, the occurrence of owl pairs at sites declined as the proportion of habitat with 0-39% canopy cover increased in the area surrounding the activity center."

In sum, these results strongly indicate that California spotted owls require stands with 50-90% canopy closure for foraging, which is exactly what Gutiérrez et al. (1992) defined as suitable habitat.

Table 3. Comparison of use and availability of stands with >70% and 40-69% total canopy closure. Though it appears that selection for >70% canopy closure may be more significant than selection for 40-69% canopy closure, Zabel et al. (1992) lumped >70% with 40-69% canopy closure for analysis of preference by the owls (reprinted from Zabel et al. 1992).

National Forest	Total Canopy Closure	Breeding season		Nonbreeding season	
		mean % area within home ranges by canopy closure	mean % of locations	mean % area within home ranges by canopy closure	mean % of locations
Sierra NF mixed conifer	40-69%	67.7	68.5	59.8	64.4
	>70%	13.2	22.2	16.4	22.2
Sierra NF riparian oak	40-69%	50.1	41.6	34.7	38.5
	>70%	27.3	48.8	31.6	47.4
Lassen NF	40-69%	26.3	20.4	25.7	18.5
	>70%	41.1	64.7	39.6	67.5

C. Multi-layered dense stands

Nesting and roosting requirements. Gould (1977) observed that of 192 northern and California spotted owl territories: "the quality of the forest was quite similar: a multi-layered forest with a diversity of tree species." This initial observation of selection for multi-layered stands, typically associated with old growth or mature forests, is supported by later studies. Bias and Gutiérrez (1992), for example, found greater variation in tree size in nest stands compared to random plots, and Moen and Gutiérrez (1997) found higher structural diversity in roosting and nesting stands compared to random plots, features indicative of multi-layered stands. Similarly, in southern California, LaHaye et al. (1997) found owls select multi-layered stands often with a conifer overstory and hardwood understory.

Several studies also found that owls select stands with greater numbers of trees than random plots when nesting and roosting. Moen and Gutiérrez (1997), for example, found more live trees in nest stands than random plots and Bias and Gutiérrez (1992) documented greater basal area of medium, mature and old growth trees in nest stands and of medium and old growth trees in roost stands than in random plots, indicating denser stands.

Foraging requirements. Both of the primary studies on foraging habitat found selection for stands with a multi-layered canopy (Call 1990, Laymon 1988). Call (1990) documented that foraging owls select stands with multiple vegetation strata (canopy layers) and Laymon (1988) found that foraging owls prefer stands with little vegetation between the ground and 33' and higher foliage volume between 33-130', which is produced by a multi-layered canopy. This attribute is likely selected because it affords owls a range of heights to perch and locate prey.

D. Large snags and downed woody debris

Nesting and roosting requirements. Spotted owls have been documented to select stands for nesting and roosting with greater numbers and basal area of snags (standing dead trees) than random plots (Bias and Gutiérrez 1992, Laymon 1988, LaHaye et al. 1997). Snags provide nesting and perching sites for the owl and potentially increase prey abundance. For example, the flying squirrel, the owl's main prey item in the northern Sierra Nevada, requires large snags with cavities for denning and as a result may be more common in stands with a greater abundance of snags (Carey 1991, Carey 1995, Weigl and Osgood 1974). Snags also likely attract woodpeckers and secondary cavity nesting birds, minor prey items of the owl (Rosenberg et al. 1996).

Foraging requirements. California spotted owls chose stands for foraging with higher basal area of snags than random sites in both Call's and Laymon's studies. Additionally, Laymon (1988) found that owls select stands with more and larger snags. Both studies indicate that large snags are a critical component of owl foraging habitat. These studies also documented that owls select stands for foraging with more downed woody debris. Call (1990) found significantly greater amounts of downed woody debris 1-11.8" and >11.8" diameter in stands used by owls for foraging compared to random plots and Laymon (1988) documented that optimal foraging habitat contains moderate levels of small dead and down material. Similar to snags, downed wood likely increases prey abundance (Maser et al. 1978).

E. Selection for other features

Gould (1977) documented that 89% of northern and California spotted owl territories occurred on the lower slopes of canyons, 90% had water courses within .3 km, and more occurred on slopes with a north aspect. Irwin (2003) found that California spotted owls were more likely to

forage in stands if they were closer to water and at lower elevations. Other studies have either not quantified these variables, or in the case of aspect did not find a statistical difference (Bias and Gutiérrez 1992, LaHaye et al. 1997). All of these observations require more data to make definitive conclusions or may be factors that co-vary with other characteristics selected by the owl.

F. Relationships between owl demography and habitat features

Three recent studies have attempted to relate habitat features to California spotted owl site occupancy, survival and productivity (North et al. 2000, Hunsaker et al. 2002, Blakesley et al. In press). Because owls may occur in less than optimal habitat, these studies have an advantage over studies that only considered owl selection of habitat where they occurred because they compare habitat features directly with indicators of owl status. In general, these studies support a conclusion that the California spotted owl requires late-successional forests to sustain populations.

North et al. (2000) related reproductive success to weather and nest-site structure based on nine years of demographic data from the Sierra National Forest and Sequoia/Kings Canyon National Park study areas, finding that higher reproduction was associated with aspect, shrub cover and foliage volume above the nest in oak woodlands, and high foliage volume in conifer forests. North et al. (2000) concluded:

> "Oak woodland and conifer forests have very distinct structures and composition, yet nest sites in both forests had 3 common features: canopy cover, tree density and foliage volume. Owl nests were consistently located in sites with 75% canopy cover, 300 stems/ha, and 40,000 m^3/ha of foliage volume."

Hunsaker et al. (2002) related owl occupancy and productivity to the amount of area in various canopy cover classes in 72, 168, and 430 ha areas surrounding owl activity centers on the Sierra National Forest, finding that both occupancy and productivity were related to high canopy closure. For occupancy, Hunsaker et al. (2002) found that when canopy cover was 20-39% at the activity center, occupancy was significantly lower than when canopy cover was either 50-69% or 70-100%. Similarly, productivity was correlated with high canopy closure with Hunsaker et al. (2002) concluding:

> "For both image types and across the three analysis areas, scores of productivity were positively correlated with the proportion of the analysis area having greater than or equal to 50 percent canopy-cover and negatively correlated with those having less than 50 percent cover."

Lee and Irwin (In review) reanalyzed data used by Hunsaker et al. (2002), confirming the results, but finding that canopy cover positively influenced probability of nesting rather than the productivity of nesting pairs. This result agrees with other studies that show habitat exerts the greatest influence on site occupancy and apparent survival, but that variation in fecundity is more determined by weather and other factors (Franklin et al. 2000, Blakesley et al. In press). It is important to note that population trend in California spotted owls is documented to be primarily influenced by adult survival rather than fecundity (Noon and Biles 1992, Franklin et al. 2004).

Blakesley et al. (In press) compared occupancy, apparent survival and reproduction of owls on the Lassen Study Area to vegetation in owl nest areas (203 ha circle) and core areas (814 ha circle). Site occupancy was positively correlated with the amount of the nest area comprised of large trees (>24" dbh) and >70% canopy closure, and negatively associated with the amount of the nest area comprised of medium sized trees and >70% canopy closure, and unforested or small tree area. Apparent survival was positively associated with the

amount of the core area occupied by stands with large trees, 40-100% canopy closure and presence of large remnant trees (>30" dbh). Reproductive output was negatively associated with the amount of the nest area that was unforested or dominated by small trees. Contrary to Franklin et al. (2000), Blakesley et al. (In press) did not find a negative association between the amount of interior forest and reproductive output. They suggest that this is because owls on the Lassen do not rely on dusky-footed woodrats, which prefer edges and more open habitat to interior forest, as they do in Franklin et al.'s study area in northern California.

These three studies further highlight the California spotted owl's dependence on large trees (>20-24" dbh) and high canopy closure (>50%).

G. Home range size and landscape scale habitat requirements

Using radio-telemetry, several studies have estimated home range size of the California spotted owl in the Sierra Nevada (Call 1990, Laymon 1988, Zabel et al. 1992). For example, estimates of mean breeding season home range size from three studies in mixed conifer forests, using the 100% minimum convex polygon (MCP) method, were 2,114 acres based on 12 radio-marked owls on the Eldorado National Forest (Laymon 1988), 3,137 acres based on five radio-marked owls on the Tahoe National Forest (Call 1990), 5,423 acres based on nine radio-marked owls on the Lassen National Forest and 1,799 acres based on 24 radio-marked owls on the Sierra National Forest (Zabel et al. 1992) (Table 4). Though there is a wide range of variability in this data, these studies indicate that breeding season home ranges are generally larger in the northern Sierra Nevada than either the central or southern Sierra Nevada.

Zabel et al. (1992) found that home ranges were considerably larger during the nonbreeding season than the breeding season with a mean of 14,677 acres for seven owls in the Lassen National Forest and 5,943 acres for 18 owls in mixed conifer forests of the Sierra National Forest (Table 4). Conversely, both Call (1990) and Laymon (1988) found similar home range sizes during the breeding and nonbreeding seasons. Both Call (1990) and Zabel et al. (1992) found larger home ranges when the breeding and nonbreeding seasons were combined, however. The former documented a mean of 4,085 acres for five birds on the Tahoe National Forest and the latter found a mean of 12,927 acre on the Lassen National Forest and 5,969 on the Sierra National Forest. Based on Zabel et al. (1992) alone, combined home ranges, like breeding season home ranges, were larger in the northern Sierra Nevada than the southern, but if Call (1990) is also considered, this pattern no longer holds true. Breeding, nonbreeding and combined home ranges of owls in Sierra National Forest riparian oak habitats were consistently smaller than home ranges of owls in mixed conifer forests, regardless of latitude. Mean home ranges in these habitats ranged from 700-1,000 acres (Zabel et al. 1992). Overall, these studies indicate there is a wide range of variability in home range size of the California spotted owl, ranging from a mean of 4,000 to 13,000 acres for combined breeding and non-breeding season owls in mixed conifer forests of the Sierra Nevada.

Regardless of the variability in home range size, the above findings indicate the owl may require large areas of suitable habitat (e.g. stands dominated by large trees, with high canopy closure (>70%), multi-layered canopies and large numbers of snags). What is unknown, however, is what proportion of each California spotted owl home range must be suitable for them to remain viable; nor is it known what proportion of the landscape as a whole must be in a suitable condition to support a viable number of owl pairs in close enough proximity to each other to facilitate reproduction and

Table 4. Estimated home range size from three studies, using the 100% MCP method.

Mean Home Range Size (acres)	Call 1990	Laymon 1988	Zabel et al. 1992		
			Lassen NF mixed con.	Sierra NF mixed con.	Sierra NF Oak
Individual birds breeding season	3,137 +/- 450	2,114	5,423 +/- 5,194	1,799 +/- 787	715 +/- 624
Individual birds nonbreeding season	2,969 +/- 417	2,074	14,677 +/- 8,252	5,943 +/- 4,530	762 +/- 469
Individual birds combined	4,085 +/- 492		12,927 +/- 10,132	5,969 +/- 4,640	1,043 +/- 866
Pairs breeding Season			3,014	2,515 +/- 874	457 +/- 274
Pairs nonbreeding season			17,292	7,201 +/- 6,901	819 +/- 251
Pairs combined				7,709 +/- 7,184	876 +/- 304

genetic exchange and avoid extinction from demographic stochasticity.

To date, three studies have made crude attempts at describing habitat within California spotted owl home ranges (Zabel et al. 1992, Call et al. 1992). Zabel et al. (1992) classified forest stands within home ranges of three study areas into one of five tree size classes and canopy closure classes both for total and dominant medium trees (11-20" dbh) and more stands with >70% canopy closure than available on the landscape. Whereas, both large trees and stands with 40-69% canopy cover occurred in the home ranges in proportion to their availability on the landscape. Hunsaker et al. (2002) compared owl occupancy and productivity at known owl sites based on nine years of data collected on the Sierra National Forest to the proportion of several canopy cover classes in 72, 168 and 430 ha circles, which approximated the 50%, 70% and 90% minimum convex polygons from radio-marked birds. Canopy cover classes were calculated using both aerial canopy cover, using aerial photographs, USGS topographic maps and orthoquads. This analysis shows that, excluding home ranges in mixed conifer forests of the Sierra National Forest, a majority of stands in the home ranges were dominated by trees over 21" and that in all three study areas a majority of stands had a total canopy closure over 40% (Table 5). Call et al. (1992) found that owl home ranges had less clearcut, shrub or plantation areas, more photography and Landsat. Hunsaker et al. (2002) found that owl occupancy increased as the proportion of the surrounding area with canopy cover 0-39% decreased and that the probability of a site supporting breeding activity increased as the proportion of the area in 70-100% and 40-49% canopy cover classes increased based on aerial photography. Using Landsat, the area with canopy cover >50% was identified as a significant factor in probability of breeding. Hunsaker et al. (2002) concluded:

> "For sites that consistently produced young, the median proportion of good habitat

(canopy cover greater than 50 percent) was usually about 10% higher than for unproductive sites. The values ranged from 75 percent of the 72 ha analysis area to 60 percent of the largest analysis area."

Results of all three studies suggest that owls require large areas of continuous forest with high canopy closure, large trees and other characteristics of late-successional forest with results from Hunsaker et al. (2002) suggesting that such characteristics should occupy roughly 60% of the home range.

IV. Population Status

Population Distribution. Based on surveys since the 1970s, there are a total of 1865 spotted owl locations in the Sierra Nevada (US Fish and Wildlife Service 2003, p. 7584). These sighting records are drawn from two separate databases. The largest database created by the California Department of Fish and Game (CDFG) contains 1771 sites. (Gould 2002, unpublished data). The second database created by Sierra Pacific Industries (SPI) contains records for 255 owl territories (Sierra Pacific Industries 2002). The database developed by SPI contains many sites that overlap with the CDFG database. When these databases were merged (US Fish and Wildlife Service 2003), the SPI database identified 94 sites not previously recorded by

Table 5. Mean tree size and dominant and total canopy closure classes of owl home ranges on three study areas from Zabel et al. (1992).

	Sierra NF mixed conifer	**Sierra NF oak**	**Lassen NF mixed conifer**
Tree size class (dbh inches)			
11- 20	83.9%	8.3%	30%
21-35	9.5%	91.2%	25.1%
>35	3.2%	0%	37.7%
Dominant canopy closure (%)			
40-69	35.4%	54.2%	25.1%
>70	.2%	19.4%	7.6%
Total canopy closure (%)			
40-69	67.7%	50.1%	26.3%
>70	13.2%	27.3%	41.1%

Table 6. Year spotted owl sites last visited. Only unique sites from each database are displayed. Data from California Department of Fish and Game (2002) and Sierra Pacific Industries (2002).

Year Last Visited	CDFG Database		SPI Database	
	Sites Visited	Running Proportion of Sites Visited (%)	Sites Visited	Running Proportion of Sites Visited (%)
1974	3	0		
1975	2	0		
1976	6	1		
1977	1	1		
1978	3	1		
1979	1	1		
1980	10	1		
1981	11	2		
1982	12	3		
1983	7	3		
1984	9	4		
1985	3	4		
1986	12	5		
1987	24	6		
1988	44	8		
1989	93	14	1	1
1990	131	21		1
1991	254	35	3	4
1992	384	57	8	13
1993	100	63	8	21
1994	103	68	24	46
1995	63	72	22	69
1996	53	75	7	77
1997	57	78	1	78
1998	55	81	8	86
1999	124	88	5	92
2000	45	91	2	94
2001	159	100		94
No record	2	100	5	100
TOTAL SITES	**1771**		**94**	

CDFG. Although there are similarities between the two databases, the same information was not collected for each site thus making complete integration of the two data bases challenging.

The reliability of a site in the CDFG databases is determined by the nature and frequency of surveys that have been undertaken at the site. If an owl site has been surveyed following the regional protocol six times in two years and is extant in the period 1990 to present, then the site is considered reliable for the period 1990 to present (California Department of Fish and Game 2002). Of the 1771 sites in the CDFG database, 1517 (86%) are considered reliable for the period 1990 to present, 25 (14%) are not reliable, and reliability was not determined on three sites. For the SPI database, the nature of

Table 7. Best status for territories in the CDFG database.

Reproductive Status	CDFG Database	
	Number of Sites	Proportion (%)
Pair	1100	62
Territorial	309	17
Single	358	20
Not recorded	4	0
TOTAL SITES	**1771**	

the field visit made to each site is reported. Visits ranged from "Protocol Survey", "Survey", "Protocol Follow-up", and "Follow-up." Assuming that "Protocol survey" and "Protocol Follow-up" indicate that the surveys and follow-up visits were completed to the regional protocol, of the 94 unique sites in the SPI database only 34 had been surveyed using the regional protocol. Part of meeting the regional protocol is to survey the site 6 times within 2 years. Of these 34 sites to which the regional protocol had been applied, only 19 had been surveyed 6 times over any period of time and several of these sites did not accrue at least 6 surveys within 2 years. Thus, fewer than 19 sites in the SPI database can be considered additions to the CDFG database that might be considered reliable from 1990 to present according to the standards set when the CDFG database was originally developed.

The strength of the sighting database can also be assessed by examining the year that a site was last visited and the best ever site occupancy recorded for that site. As can be seen from Table 6, a large proportion of the sites from both the CDFG and the SPI database have not been visited in recent years.

As shown above, approximately 70% of the owl sites in either database have not been visited and verified since 1995. Thus, the present status of many of the owl sites in these databases is not known and robust inferences about the number and distribution of spotted owl sites based on these data are not possible.

The best ever reproductive status can be determined from the CDFG database. Due to internal inconsistencies and difficulty interpreting entries in the SPI database, determination of the best reproductive status for a given site is not possible. For the 1771 sites in the DFG database, 62% of the sites have supported pairs as the best status sometime in their history, for 17% territorial owls were the best reproductive status and for 20% single birds were the best reproductive status (Table 7). Owls were not detected on 4 four sites.

The CDFG database incorporated detailed information about every owl territory in the Sierra Nevada, including location, year last detected, reproductive status and other information, into a Geographic Information Systems (GIS) database. The SPI database includes sighting records for owl sites visited by their organization. This database also contains some information on the activity observed at each site. We have used these databases to explore the distribution properties of the California spotted owl in the Sierra Nevada. Several authors have asserted that the California spotted owl's distribution is continuous in the Sierra Nevada, but failed to state the methodologies or assumptions used in making this determination (e.g. Verner et al. 1992). We used the GIS database produced by Gould (unpublished) to determine whether the distribution is in fact continuous, based on different assumptions of what distance constitutes continuous territories. This was accomplished by placing circles of two and 3.5 mile radii around each territory and then visually determining whether there were breaks

in the distribution. Circles were placed around both all reliable territories and reliable pairs. The smaller radius was chosen in order to approximate the size of owl home ranges (two miles represents about an 8,000 acre home range), which range from a mean of roughly 4,000 acres to 13,000 acres, excluding riparian home ranges (Call 1990, Zabel et al. 1992). We approximated home range size because interconnected home ranges represent the greatest degree of continuity possible for a population and provide the highest likelihood that dispersing juveniles and adults will locate vacant territories. The larger radius was chosen to approximate the known dispersal distances of juvenile northern spotted owls. Thomas et al. (1990) found that of all radio-marked juveniles in several studies about 75% traveled at least seven miles. Our rationale was that if territories are within the approximate distance traveled by dispersing juveniles than there is some chance that they will be colonized should they become vacant.

Similar to Beck and Gould (1992), we defined "Areas of Concern" (AOC) as places where the overall owl distribution was broken, narrow or characterized by low owl densities. We have labeled each AOC numerically (I to IX) from north to south (Figure 1). We also display the AOCs identified in Beck and Gould (1992) for comparison and these are labeled as well (A to B and 1 to 8). For this petition, AOCs were first identified using reliable pairs with the two mile radius because this combination produced the strongest patterns (Figure 1). We do, however, discuss all the combinations in relation to each AOC and population continuity as a whole (Figure 2). In order to determine if gaps in the owl distribution or low owl densities related to forest cover type, we consulted maps of forest type and late successional ranking found in Langley (1996) and developed by Franklin and Fites-Kaufmann (1996). The following paragraphs describe each AOC identified by our analysis, many of which, but not all, were also identified by Beck and Gould (1992)(Table 8).

Table 8. Approximate correspondence between Areas of Concern (AOC) identified by Beck and Gould (1992) and in the analysis presented in this petition.

AOCs taken from Beck and Gould (1992)	AOCs Determined in This Analysis
A, 1	I
2	II
3	III
4	IV
5	V
6, 7	VI
none	VII
B	VIII
8	IX

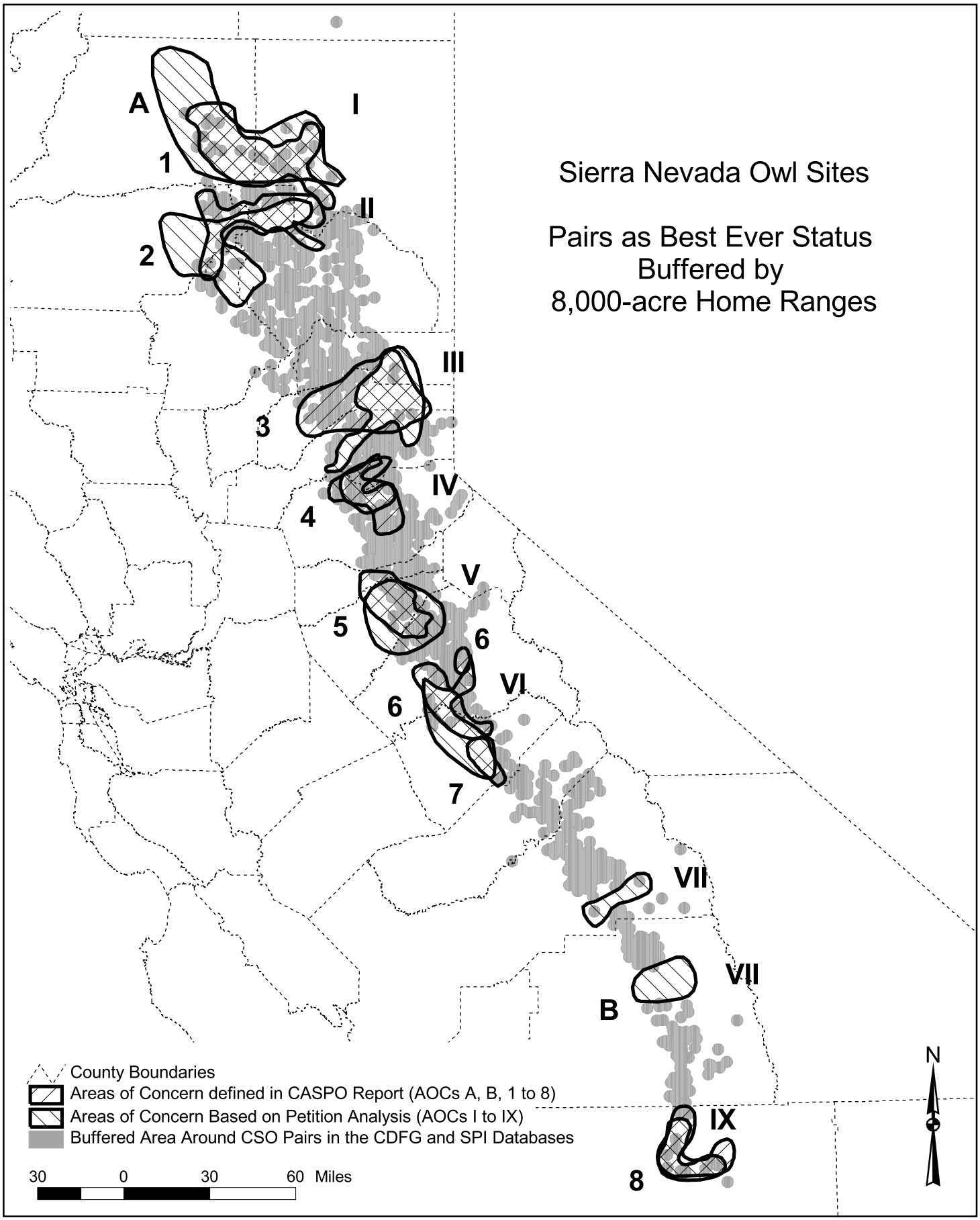


Figure 1. Area in gray represents a home range of 8,000 acres (2-mile radius) around sites with owl pairs. All owl sites with the best status of a pair that were relaible from 1990 to present in the CDFG database and all owl pairs identified in the SPI database are displayed. Areas of concern for both the CASPO Report and this petition were based on low owl densities, habitat fragmentation, and mixed ownership patterns.

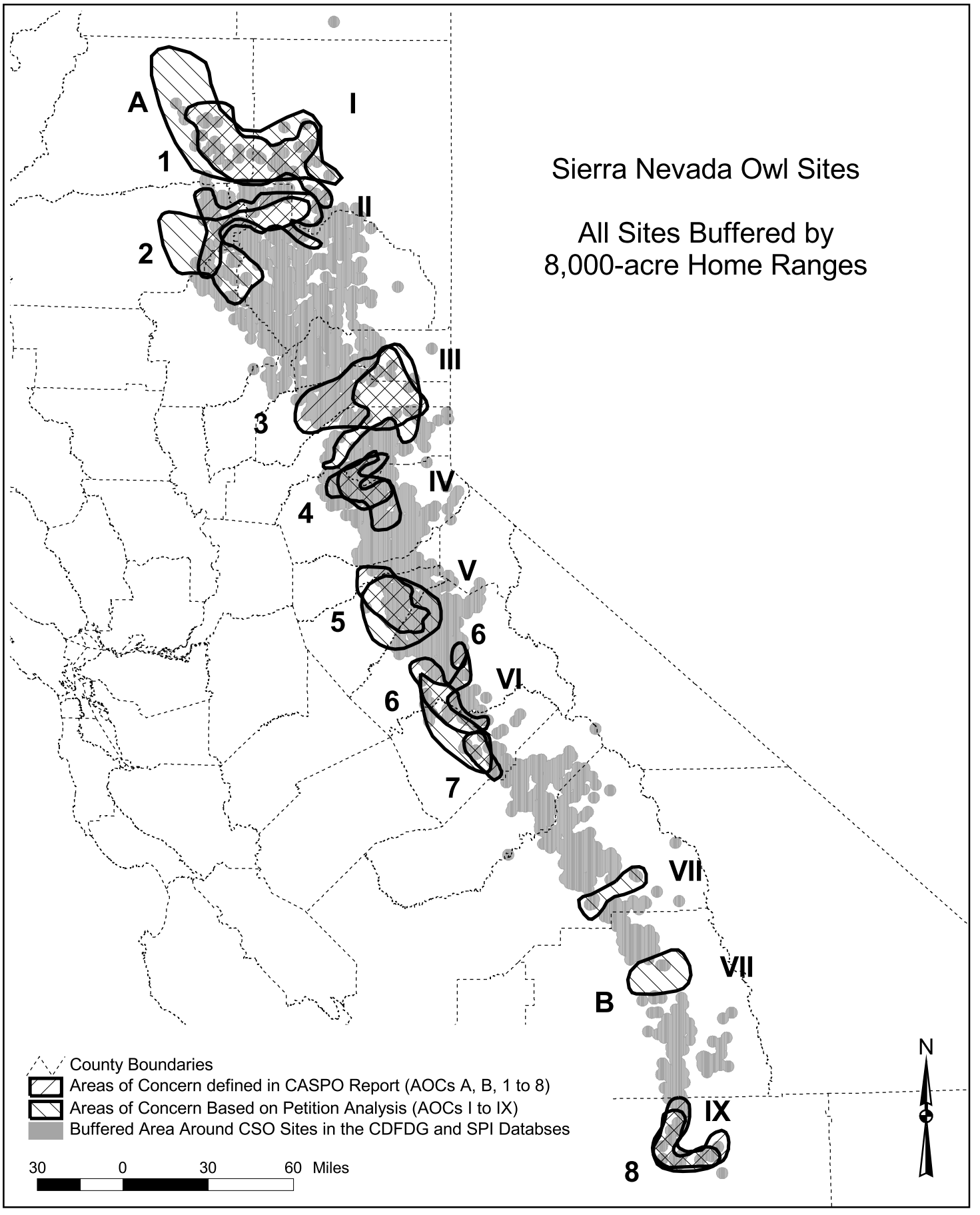


Figure 1. Area in gray represents a home range of 8,000 acres (2-mile radius) around all owl sites. All owl sites that were relaible from 1990 to present in the CDFG database and all owl pairs identified in the SPI database are displayed. Areas of concern for both the CASPO Report and this petition were based on low owl densities, habitat fragmentation, and mixed ownership patterns.

Area of Concern I

Most of this AOC was also described by Beck and Gould (1992) as AOC 1 and A. It includes a significant portion of the Lassen National Forest, which Beck and Gould described as being:

> "characterized by habitat fragmentation that decreases the density of owl pairs, makes successful dispersal more difficult, and reduces the quick replacement of owls in vacated habitat."

Habitat fragmentation in this AOC stems from both natural and anthropogenic (logging) factors. We have expanded the boundary of the AOC compared to Beck and Gould (1992) to the northwest to include an area that they labeled Area A, which could serve as the connection between the California and northern subspecies. Owl densities in this AOC are generally lower than in other portions of the range. A number of both reliable pairs and territories (Figures 1 and 2) appear to be isolated from other territories by more than four miles, indicated by the two mile radius circles.

Area of Concern II

This AOC covers portions of the western and southern Lassen National Forest into the northern part of the Plumas National Forest, where there is a nearly complete break in owl distribution from east to west. Beck and Gould (1992) also identified this AOC 2, stating:

> "Area 2 is a gap in the known distribution of spotted owls from the western to the eastern edge of the owl's range in the northern Sierra Nevada. If few birds and little habitat exist in this area, north-south dispersal could be impeded. This area and others where few surveys have been done are, however, capable of producing owl habitat and may not be breaks in distribution."

To date, there is no information to indicate owls fill this gap. We included a somewhat larger area in this AOC, using the gap in the distribution of reliable pairs and the two mile radius.

Beck and Gould (1992) did not explore possible causes for this gap, but did state the area is capable of supporting owl habitat. Figures in Langley (1996) show a mix of private lands and mixed conifer habitat on Forest Service lands in this area. Portions of the mixed conifer habitat were characterized as Rank zero or one in terms of their contribution to late successional forest function by Franklin and Fites-Kaufmann (1996), indicating that habitat loss and fragmentation may in part be responsible for this gap.

Area of Concern III

This AOC is a large gap in owl distribution covering the central potion of the Tahoe National Forest down into the American River, nearly creating another east to west gap in distribution. Beck and Gould (1992) also included this area, minus the American River portion, as AOC 3 because of checkerboard ownership, granite outcroppings and red fir forests. This gap remains quite apparent when all reliable territories are considered with the two mile radius. According to Franklin and Fites-Kaufmann (1996), this AOC makes a fairly minimal (rank 1 or 2) contribution to late successional forest function. Because of the checkerboard ownership and the fact that this AOC occurs in an area with the longest history of intensive logging in the Sierra Nevada (see below), it seems likely that, in addition to natural habitat fragmentation from granite outcroppings, fragmentation related to logging is at least in part responsible for this gap in owl distribution.

Area of Concern IV

Beck and Gould (1992) identified this area as AOC 4 based on habitat fragmentation and checkerboard ownership with very low owl

densities on private inholdings. According to our analysis, the owl distribution is fairly continuous in this area, but we have left it as an AOC because of the identified habitat fragmentation and low owl densities on private lands. Part of this AOC is within the Eldorado demography study area.

Area of Concern V

This AOC is found in the northern portion of the Stanislaus National Forest, extending beyond its western boundary. Beck and Gould (1992) also identified this area as AOC 5 because of habitat fragmentation from unspecified causes and private land inholdings. The analysis of all reliable pairs with the two mile radius circle shows that this area also has low owl densities and nearly forms a third gap in the distribution. Based on maps in Langley (1996), the area is dominated by westside mixed conifer, indicating logging and not natural factors, is the cause of habitat fragmentation.

Area of Concern VI

A combination of AOCs 6 and 7 identified by Beck and Gould (1992), this AOC is found west of Yosemite National Park in the Stanislaus and Sierra National Forests. According to Beck and Gould (1992), the northern portion (AOC 6) has little remaining habitat because of extensive, recent fires and the southern portion (AOC 7) has a high degree of natural habitat fragmentation that has been accentuated by logging. The area is classified as having predominantly low ranks (1 and 2) for contribution to late successional forest function (Franklin and Fites-Kaufmann 1996). In contrast, forests in the adjacent Yosemite National Park have high ranks for contribution to late successional forest function. Apparently, the fires in the northern portion of the AOC did not affect the Park to the same degree, perhaps because of their longstanding prescribed burning program and lack of interrelated effects of logging and fire. Similarly, in the southern portion of the AOC, the Park does not have the compounding effect of logging overlaid on natural fragmentation.

Area of Concern VII

This AOC is found at the southern end of the Sierra National Forest near the Kings River Canyon and adjacent to the Sierra demography study area, where there is an almost complete west to east gap in owl distribution. It was not identified by Beck and Gould (1992). Though we do not know what the cutting history is for this particular area, Franklin and Fites-Kaufmann (1996) characterized it as mixed conifer with a low rank for contribution to late successional forest function.

Area of Concern VIII

Beck and Gould (1992) identified this area as a point where the distribution of owl habitat is particularly narrow (AOC B) and indeed figures in Langley (1996) show that the area of forest types utilized by the owl is very narrow. Within the bounds of Sequoia National Park, this AOC has never been logged. Franklin and Fites-Kaufmann (1996) characterized the area as having a high rank (5) for contribution to late-successional forest function. Our analysis shows the area as a break in the owl distribution; however, it was last surveyed in 1988 and 1989. At that time, several territories were found which are no longer considered reliable. It should be a priority to conduct surveys in this area and confirm that continuity remains.

Area of Concern IX

Also identified as AOC 8 by Beck and Gould (1992), this area is the southern terminus of the California spotted owl's range in the Sierra Nevada and is characterized by low owl densities and habitat fragmentation. Much of the AOC is low elevation foothills gray pine with scattered ponderosa pine and oak, as well as eastside pine and is mostly classified as making a low (0-2) contribution to late-successional forest function (Franklin and Fites-

Kaufmann 1996, Langley 1996). This area is critical because it links populations in the Sierra Nevada and southern California.

Besides these obvious AOCs, a couple of other facets of the known owl distribution are of interest. First, the distribution of reliable owl pairs in the Tahoe and Plumas National Forests is generally fragmented when the two-mile radius circle is considered. Though there are no landscape scale descriptions of habitat of a high enough quality to correlate this distribution with habitat variables, it seems likely that the owl distribution in these forests as well as elsewhere in the Sierra Nevada is at least in part determined by habitat fragmentation and loss due to logging. This is based on the fact that the Tahoe and Plumas have large private land inholdings, where logging has been and is currently largely unrestricted and intensive and that both forests occur in the portion of the range with the longest history of logging. Second, the known distribution of owls in the Sierra Nevada is for the most part limited to the bounds of the National Forest system, including private land inholdings. Because survey efforts outside National Forests have been limited, there is no way to prove or disprove lack of owls outside national forest boundaries, but given the lack of regulation outside national forest boundaries, it remains a distinct possibility that the owl has been largely eliminated from many private lands.

In sum, our analysis of the spatial distribution of owl territories and pairs in the Sierra Nevada indicates that there are a number of discontinuities and areas of low owl density that likely relate to a combination of natural and anthropogenic habitat fragmentation. Given that there is no indication that owl habitat is increasing in the Sierra Nevada and that owl populations are declining, it is likely that the owl distribution will become increasingly fragmented without additional protection under the Endangered Species Act.

Southern California. In total, there are approximately 412 owl sites in southern California (Gould unpublished data). Of these, 329 territories are considered reliable, including 305 pairs, 93 single owls and 14 territorial singles (Gould unpublished data). As stated above, the spotted owl in southern California occurs in a discontinuous distribution within at least eight mountain ranges. Stephenson (1991)

Table 9. Mountain ranges, numbers of owls and distance between ranges in southern California from Noon and McKelvey (1992)

Mountain Range	Total owl sites	Nearest Neighbor Distance (miles)
Palomar Mountain	18	18-33
Central San Diego County	9	18-33
Cuyamaca/Laguna Mountains	10	18-33
Santa Ana Mountains	2	30-40
San Jacinto Ranges	20	11-18
San Bernardino Mountains	148*	6-11
San Gabriel Mountains	54	6-20
Liebre/Sawmill Mountains	14	12-20
Tehachapi Mountains	4	Unknown
Tecuya Mountains	5	9-12
Los Padres Ranges	65	8-12
So. Santa Lucia Mountains	12	32-45
No. Santa Lucia Mountains	39	45
Total	400**	

* From Gutiérrez et al. (1999)
** Does not represent all sites in Gould (unpublished data)

surveyed these ranges from 1987-1991, providing an estimate of sites per mountain range. The estimated number of owl sites in each range varies from 2-148 and the distance between each range varies from 6-45 miles (Table 9, LaHaye et al. 1994, Noon and McKelvey 1992, Stephenson 1991).

Noon and McKelvey (1992) reviewed existing literature on population structure, dynamics and modeling and constructed a spatially explicit, simulation model to "explore the stability properties of the southern California metapopulation." The primary finding of this exercise was that owl populations in the San Bernardino and San Gabriel Mountains are critical to the long-term survival of the southern California population of spotted owls. They state:

> "Simulation results suggested that the San Gabriel/San Bernardino owl population plays a pivotal role in maintaining the southern California metapopulation."

These populations are critical because they support sufficient owl sites to remain stable and to possibly act as a source population. According to both there simulation and past modeling results, if population clusters have "moderate connectivity", they must have >20 sites to have locally stable populations. In contrast, their simulation showed that if their were "moderate to strong risks to dispersing birds", then only clusters with > 40 sites and contiguous habitat remained stable. Thus, the San Bernardino and San Gabriel populations with over 100 owl sites form not only the most stable population, but perhaps have historically acted as a source for other smaller and less stable populations. Noon and McKelvey (1992) state:

> "Simulation results suggest that, in those parts of the species' range where suitable habitat constitutes only a small fraction of the landscape, populations are unstable and have low occupancy rates. The pattern is improved if the metapopulation contains a large source population."

Given this knowledge, two serious concerns arise regarding the spotted owl population in southern California. First, large-scale population growth and development may be a major impediment to dispersal from large, source populations to smaller, isolated populations. For example, for birds to emigrate from the San Bernardino to the Santa Ana Mountains, they would have to cross 30 miles of the Los Angeles Basin. Second, over ten years of demographic data from the San Bernardino Mountains indicate this population is in sharp decline. Noon and McKelvey (1992) conclude:

> "Unfortunately, the resident territorial population of spotted owls in the San Bernardino Mountains has declined precipitously since 1987. If the territorial population is in some sort of dynamic balance with a nonterritorial (floater) population, then these sorts of declines may be accommodated over the short-term and pose no long-term threat. If these trends also characterize the other local populations, however, and were to persist for another 5-10 years, we believe the persistence of the entire metapopulation would be at risk."

Since this statement was written, the San Bernardino Mountains population has continued to decline for six additional years.

B. Population demography

The California spotted owl has been the subject of extensive study for nearly two decades with the first demography study initiated on the Eldorado National Forest in 1986, followed by studies initiated on the San Bernardino National Forest in 1987, and the Sierra and Lassen National Forests, and Sequoia/Kings Canyon National Park in 1990. These studies assessed fecundity and used mark-recapture data to estimate apparent survival, and population

trend, referred to as the finite range of population change (λ). Most attention has been focused on estimates of λ as a primary basis for not listing the owl both in 1992 (Verner et al. 1992) and in the recent U.S. Fish and Wildlife Service decision (USFWS 2003A).

Before discussing the methods and results of the demography studies, it is important to note that the Endangered Species Act does not require conclusive proof that a species is declining before it is listed as a threatened or endangered species. To the contrary, the act requires the government to provide protective measures to imperiled species as soon as possible. *Defenders of Wildlife v. Babbitt (Defenders of Wildlife)*, 958 F.Supp. 670, 680 (D.D.C. 1997), with a precautionary approach underlying all aspects of the ESA. *TVA*, 437 U.S. at 178, 194; H.R. Rep. No. 93-412, 5 (1973). Under this principle of institutionalized caution, the listing agency must list a species facing a threat of extinction even if the scientific data does not definitively and conclusively indicate that the species is threatened or endangered. *Defenders of Wildlife*, 958 F.Supp. at 680.

The ESA was intended to provide protection to imperiled species before conclusive evidence indicates imminent danger of significant population declines. *Id* at 679-680. If a species is not listed because the listing agency claims the data is inconclusive, and later data shows that the species' numbers were actually fewer than initially believed, the damage done may be irreparable. An endangered species may face extinction, and an extinct species can never be brought back. This is the "precise harm[] Congress enacted the statute to avoid." *Babbitt*, 515 U.S. 687, 698 (1995). The purpose of the ESA is to "*halt* and reverse the trend toward species extinction, whatever the cost." *Id*. at 699 (quoting *TVA*, 437 U.S. at 184) (emphasis added). Delaying listing of a species certainly will not halt any downward trends, and by the time a downward trend can be conclusively confirmed with scientific data, it may be too late for mankind to ever reverse the trend. Thus, the ESA requires that the listing agency decide whether to list a species based upon the "best scientific data . . . *available.*" 16 U.S.C. § 1533(b).This means that the agency should consider the data that is "presently available." *Defenders of Wildlife*, 958 F.Supp. at 680; *Conner v. Burford*, 848 F.2d 1441, 1454 (9th Cir. 1998). It is not appropriate for the listing agency to reach "the mere conclusion that work needs to be done," nor does the ESA require any additional studies. *Northern Spotted Owl v. Lujan*, 758 F.Supp. 621, 628 (W.D. Wash. 1991); *Southwest Center for Biological Diversity v. Babbitt*, 215 F.3d 58, 60 (D.C. Cir. 2000). The listing agency may not wait to list a species until it determines that later acquired scientific data is conclusive. *Defenders of Wildlife*, 958 F.Supp. at 680. Indeed, the ESA "contains no requirement that the evidence be conclusive in order for a species to be listed." *Id.* at 679.

Congress recognized that the extinction of a species is an irreplaceable loss of incalculable value. *TVA*, 437 U.S. 153, 177-78 (1978); H.R. Rep. No. 93-412, 4 (1973). Given the significance of such a loss, Congress chose to adopt the ESA to mandate a "policy . . . [of] 'institutionalized caution.'" *TVA*, 437 U.S. at 194. "Sheer self-interest impels us to be cautious. The institutionalization of that caution lies at the heart of [the ESA bill]." *TVA*, 437 U.S. at 178 (quoting H.R. Rep. No. 93-412 at 5). The listing agency must err on the side of caution when science cannot provide a conclusive answer. Doubt as to a species' status may exist, but Congress's intent under the best available standard was to "give the benefit of the doubt to the species" when faced with any data gaps. *Conner*, 848 F.2d 1441, 1454 (9th Cir. 1998) (quoting H.R. Conf. Rep. No. 96-697, *reprinted in* 1979 U.S.C.C.A.N. 2572, 2576); *Defenders of Wildlife*, 958 F.Supp. at 680; *FWS & NMFS, Final Endangered Species Act Consultation Handbook,* I-6 (1998). When a listing decision "is a close call" the listing agency must "err on the side of the species." *Endangered Species Act Oversight; Hearing on S. 321, Before the Senate Comm. On*

Environment and Public Works, 97th Cong. 37 (1982) (remarks of Senator Chafee).

The ESA's policy of institutionalized caution requires the listing agency to list as threatened a species if any of the five statutory factors, *see* 16 U.S.C. § 1533(a)(1), "are sufficiently implicated," even if a decline in species' numbers has not been conclusively established. *Southwest Center for Biological Diversity*, 215 F.3d 58, 60 (D.C. Cir. 2000). Threats from the five statutory factors can be far more indicative that a species is threatened than established population declines. *See Endangered and Threatened Wildlife and Plants; Re-opening of Comment Period on the Sacramento Splittail Final Rule*, 67 Fed. Reg. 13095, 13095, 13097 (March 21, 2002). Certain species are inherently difficulty to survey, and fish and wildlife abundance data has an "inherent high variability." *Id*. at 13097. This may cause scientific uncertainty regarding the species' status. Nevertheless, given the "intrinsically precautionary nature of section 4," the species should be listed because the risk to the species outweighs the lack of scientifically certain data. *Id.*

Congress intended listing a species as threatened to be a "preventive measure[] *before* a species is 'conclusively' headed for extinction." *Defenders of Wildlife*, 958 F.Supp. 670, 680 (D.D.C. 1997). "The purpose of creating a separate designation for species which are 'threatened'. . . was to try to 'regulate these animals before . . .danger becomes imminent.'" *Id.* (quoting S. Rep. 93-307 at 3 (1973)). The Fish and Wildlife Service itself has indicated that "'detection of a [statistically significant] decline should not be a necessary criterion for enacting conservation measures.'" 67 Fed. Reg. At 13097 (quoting Taylor and Gerrodette (1993)). Indeed with some species, if the listing agency "'were to wait for a statistically significant decline before instituting stronger protective measures, the [species] would probably go extinct first.'" *Id.* (quoting Taylor and Gerrodette (1993)). Listing the species as threatened is critical to ensuring stronger protective measures are instituted. It is in this framework that information on the demographic status of the owl should be considered.

Two methods have been used to estimate population trends in the California spotted owl. Leslie Projection Matrix Models were used to estimate λ on individual study areas (referred to as λ_{pm}). More recently, a meta-analysis was conducted using data from all the study areas and the new Pradel method for estimating λ (referred to as λ_t;Franklin et al. 2004). Traditional Leslie Projection Matrix Models use estimates of survival and fecundity to determine whether owls are replacing themselves within a geographically closed system. One problem with this approach is that there is no way to determine whether owls that disappear from the study area have died or emigrated. Thus, emigration and mortality are confounded so that both contribute to losses from the population. In contrast, only *in situ* reproduction adds individuals to the population. Therefore, two sources of losses (emigration and mortality) and only one source of gains (*in situ* reproduction) contribute to population trend estimates, which biases survival estimates low. Such bias is believed insignificant for adults, which are philopatric, but potentially significant for juveniles, which are obligate dispersers. Estimation of λ_t avoids this problem by considering 2 sources of losses (emigration and mortality) and 2 sources of gains (immigration and *in situ* reproduction).

The two methods thus ask fundamentally different questions: λ_{pm} measures whether survival and reproduction was sufficient to maintain the population in a geographically closed area, whereas λ_t measures whether the territorial population was being replaced, either through recruitment or immigration. A limitation of the latter method is that $\lambda_t > 1$ does not necessarily demonstrate a demographically stable population because population declines may be masked by immigration from outside the study area and such immigration is not distinguished from recruitment. Franklin et al. (2004) acknowledge this problem, stating:

> "a stationary population (i.e. $\lambda = 1$) using that newer analysis still could not demonstrate demographic stability because stationary populations could be maintained solely by immigration from other populations."

In part because of these limitations, Franklin et al. (2004) emphasize the need to consider a broad range of information on owl status and not narrowly focus on λ_t:

> "The USFWS issued a 12 month finding on 14 February 2003, not to list the owl. We believe it is important that such conservation assessments on the status of the owl be based on all the relevant data. We also believe that all the demographic evidence available—such as estimated vital rates, rates of population change, and differences between paired studies—suggest substantial caution in owl conservation and management efforts."

In accordance with the suggestion of Franklin et al. (2004), we summarize the results of the individual studies, the meta-analysis and any other relevant data.

Lassen National Forest Study Area. Beginning in 1990, researchers from the Pacific Southwest Research Station of the Forest Service initiated a study of California spotted owls on 500 square miles of the Lassen National Forest in northeastern California, including banding of 219 juvenile and 200 sub-adult and adult owls (Blakesley et al. 2001). Results from years 1990-1999 of the study were peer-reviewed and published in the Condor (Blakesley et al. 2001). Estimated apparent survival was 0.333 +/- 0.055 for juveniles and 0.827 +/- 0.015 for subadults and adults, and fecundity was 0.065 +/- 0.066 for subadults and 0.291 +/- 0.065 for adults (Blakesley et al. 2001). The finite rate of population change (λ_{PM}) for the period of study was 0.910 +/- 0.025, suggesting an annual rate of population decline of 9% per year. The 95% confidence interval for this estimate does not include 1.0 (0.862-0.959), indicating statistically significant declines.

As discussed above, bias in estimates of juvenile survival can negatively bias estimates of λ_{PM}. Blakesley et al. (2001), however, note that there are several lines of evidence to suggest such negative bias is small in their study and thus that it is unlikely that the California spotted owl population on the Lassen National Forest is stable. Blakesley et al. (2001) found a comparable value for juvenile survival as found in the San Bernardino population, which is believed to be a closed population, and a higher value than the mean estimate from 16 studies of northern spotted owls (Franklin et al. 1999). They also note that it is unlikely that they have a high rate of juvenile emigration because the study area is bound by vast expanses of unsuitable habitat on three sides and the study area is large compared to typical juvenile dispersal distances. Blakesley et al. (2001) state that juveniles can disperse >70 km and still remain in the study area. Forsman et al. (2002) found that of 711 northern spotted owl juveniles banded or radio-marked, only 8.7% dispersed more than 50 km, supporting Blakesley et al.'s conclusion. Blakesley et al. (2001) also relocated a higher proportion of banded juveniles (21%) than found for four northern spotted owl study areas (12%) by Raphael et al. (1996), suggesting fewer juveniles are emigrating out of their study area.

Even if their estimate of juvenile survival was biased, however, Blakesley et al. (2001) note that it is highly unlikely that it is biased to the extent that it masks a stable population. For the population to be stable, juvenile survival would have to be 0.790, which is higher than any estimate of juvenile survival in any study of spotted owls and would require a juvenile emigration rate of 0.578 (Blakesley et al. 2001). This emigration rate is at the high-end of estimates of juvenile emigration from three northern spotted owl dispersal studies, which averaged 0.364 +/- 0.039 and ranged from 0.295 +/- 0.044 to 0.579 +/- 0.113 (Franklin et al.

1999). For the above reasons, it is unlikely that the Lassen Study Area would have such a juvenile emigration rate.

Another potential limitation of the demography studies is that if the study area differs somehow from the regional landscape, then the observed declines could be unique to the study area. Contrary to this, Noon and Blakesley (1999) concluded:

> "[W]e believe our sample to be representative of the regional population, and that reliable inference can be made to the dynamics of the resident, territorial population of owls occupying public lands within the southern Cascades/northern Sierra Province for the period 1990-1998."

Based on the severity of the observed declines, Noon and Blakesley (1999) make strong recommendations for the protection of the California spotted owl:

> "The results of our demography study, coupled with strong evidence that California spotted owls select stands dominated by trees >24 inches dbh [note the emphasis on 24" rather than 30"] and with at least 40% canopy closure (Verner et al. 1992b, Gutiérrez et al. 1992, Zabel et al. 1992) suggest that interim measures to retain spotted owl habitat should be no less than those proposed by Verner et al. (1992a)."

Significantly, they also call for the U.S. Fish and Wildlife Service to review the status of the species for Federal listing as a threatened species:

> "Both the northern and Mexican subspecies of spotted owls are currently listed as threatened subspecies under the Federal Endangered Species Act. Both these subspecies were listed on evidence of population declines that was less extensive and less reliable than that for the California subspecies… Because levels of timber harvest are likely to increase in the near-term, we believe the U.S. Fish and Wildlife Service should thoroughly evaluate the status and trend of the California spotted owl to determine if it warrants listing as a threatened species."

This statement was made prior to the U.S. Fish and Wildlife's recent decision to not list the owl and before the Framework was weakened by the Bush Administration. Levels of timber harvest are again on the increase, again necessitating that Fish and Wildlife evaluate the status of the owl.

For the Lassen Study Area, Franklin et al. (2004) estimated similar adult survival, but slightly higher fecundity than Blakesley et al. (2001) (Table 10). In addition, the estimate for λ_t (0.985) was higher than λ_{pm} (0.910) and was not significantly different than one. The slightly higher value for fecundity was believed to be because of inclusion of an additional year of data (2000) with relatively high reproductive output (Franklin et al. 2004).

Because of differences in the inferences that can be drawn from the two methods of determining population trend, Franklin et al. (2004) don't rule out the possibility that both estimates may be correct, stating:

> "If both estimates were correct, that implied that the population of owls in the LAS was being sustained by immigration or that the population declined more steeply from 1990 to 1994 than from 1994 to 1999."

The latter reflects the fact that Franklin et al. (2004) only analyzed data from the last half of the study.

Table 10. Estimates of demographic parameters from Franklin et al. (2004) and the individual study areas.

Study Area	λ_{pm}	Mean λ_t, 95% CI	Mean apparent survival[a]	Trend in real numbers of territories or number of owls
LAS	0.910[b]	0.985 (0.934-1.036)	0.837	Decline in real numbers and significant negative trend in site occupancy.
ELD	0.948[b]	1.042 (0.950-1.133)	0.823	Empirical estimates of abundance showed a 4.9% decline 1993-2000
SIE	0.889[b]	0.961 (0.915-1.008)	0.824	Decline in real numbers of owls.
SKC	0.973[c]	0.984 (0.892-1.076)	0.891	Increased number of sites.
SAB	0.910[b]	0.978 (0.929-1.026)	0.814	Decline in numbers of occupied sites through 2003.

a. From Franklin et al. (2004)
b. Significantly different from a stable population (P < 0.00001)
c. Not significantly different from a stable population (P = 0.0797)

Franklin et al. (2004) offer one other possible reason for the discrepancy between the two estimates:

> "Because the smaller LAS study area was designated post hoc during this analysis (i.e. to be comparable to the other studies in the meta-analysis, contiguous segments of LAS were chosen that would serve as a *de facto* density study area by virtue of their complete survey each year), the assumption of equal capture probability of banded and unbanded birds may not have been met. In addition to the behavioral response of animals to being trapped, "trap response" may have been present in the data if field personal learned where to find individual owls over time, increasing the probability that banded owls were recaptured… If trap response was present, it would have positively biased estimates of λ_t."

Thus, both Blakesley et al. (2001) and Franklin et al. (2004) found a low value for apparent adult survival, which as discussed below is a key demographic parameter, and found the population to be declining, although Franklin et al. (2004) did not find statistically significant declines.

Two other analyses provide further support for a declining Lassen population. USFWS (2003) noted that territorial female owls declined from 56 to 37 from 1993 to 2001, corresponding to a 5% annual decline, which is not significantly different from the 9% decline predicted by λ_{pm}.

Using logistic regression, Blakesley (2003) modeled site occupancy as a function of year and forest cover types and found strong evidence of a declining trend in occupancy overtime, concluding:

> "The negative time trend in site occupancy corroborates evidence from other analyses of Lassen spotted owl demographic data that the population declined during the study period."

In summary, several lines of evidence strongly suggest the California spotted owl is declining in the northern portion of its range. Blakesley and Noon (2003) state:

> "Four lines of evidence suggest a decline in the population of territorial spotted owls on the Lassen study area from 1990-2001. No

evidence suggests that the population was increasing during this time."

These declines are cause for concern given findings by Blakesley (2003) that site occupancy, apparent survival, and nesting success were all positively correlated with amount of habitat with high cover and large trees, and that the Lassen Study Area is targeted for extensive logging under the Quincy Library Group Project.

Sierra National Forest and Sequoia/Kings Canyon National Parks Study Areas. From 1990-2002, the demography of California spotted owls was investigated on three study areas, including one in relatively pristine habitats of Sequoia/Kings Canyon National Parks (SNP) and two others in the Sierra National Forest (SNF and NS) (Steger et al. 2002). One of the latter studies (NS) was initiated in 1994 to increase the size and power of the studies. In total, they captured over 300 individual owls between the three study areas. Differences in the status of populations between the National Forest and National Parks are of primary interest because these differences suggest that intensive habitat destruction and degradation on the national forest may be impacting owl populations.

As expected, based on vastly different management of the two study areas, there were differences in the status of populations in the Parks compared to the Forest. The finite rate of population change (λ_{pm}) for SNP was 0.973 compared to 0.889 for the SNF and NS combined (Steger et al. 2000).[2] Furthermore, λ_{pm} in SNP was not significantly different than one, indicating the possibility of a stable population, whereas, λ_{pm} in SNF and NS was significantly different than one. Differences in finite rate of population change between the Park and National Forest are likely due to a difference in adult survivorship, which is the parameter that most influences λ (Noon and Biles 1990). Adult survivorship was 0.886 in SNP compared to 0.8319 on the SNF (Steger et al. 2002). Steger et al. (2000) conclude:

> "The difference between the SNF and SNP is largely attributable to the higher apparent non-juvenile survival rates observed in SNP, as λ is most sensitive to this value (Noon et al. 1992).

The Park also supported greater densities of owls with a mean crude density of 0.48 owls/mi^2 compared to 0.42 owls/mi^2 on SNF and 0.27/mi^2 on NS.

Similar differences between the Park and national forest were found by Franklin et al. (2004) in the meta-analysis of the California spotted owl, who concluded:

> "In the Sierran province, the SKC population on national park lands seemed to be the most viable population with the highest adult apparent survival, a positive trend in λ_t, and no evidence of a trend in fecundity. At the opposite end of that spectrum was the SIE study, which had the lowest estimate of λ_t, low adult apparent survival, and declining trends in both λ_t and fecundity."

In addition to finding higher values of λ_t and fecundity for the Sequoia/Kings Canyon study area compared to the Sierra National Forest, Franklin et al. (2004) found statistically significant higher adult survival in the Park compared to the national forest.

For the Sierra National Forest study areas, Franklin et al. (2004) found a λ_t of 0.961 with a 95% confidence interval ranging from 0.915 to 1.008, leading the authors to conclude:

[2] The most recent year in which λ was reported.

> "The SIE had the lowest estimate of λ with 95% CI that barely overlapped λ = 1, which suggests that the owl population on the SIE was declining."

Moreover, estimates of realized change predicted a declining population on the Sierra National Forest throughout the study period with Franklin et al. (2004) concluding:

> "The SIE population decreased steadily from 1993, resulting in a population that was substantially lower and different from the initial population, on the basis of 95% CI. In 1999, 70.9% of the SIE population remained from the initial population in 1993."

Real numbers of owls also declined during the study with numbers on the Sierra National Forest falling from 69 to 55 between 1991 and 2000 on the original study area, and from 37 to 29 between 1994 and 2000 on the new study area (USFWS 2003A). In contrast, owl numbers increased in Sequoia/Kings Canyon National Park from 54 to 64 from 1990 to 2000.

Franklin et al. (2004) identified three potential causes for these differences: 1.) differences in amount of oak-woodland and sequoia groves, 2.) differences in timber management, or 3.) differences in prescribed burning history. Sequoia/Kings Canyon National Park contains more Sequoia Groves, had a longer and more active history of prescribed burning, and has been largely protected from timber harvest. In contrast, the Sierra National Forest has slightly more owl territories in oak woodlands, a more recent history of prescribed burning and an active history of timber harvest that has resulted in substantial reductions in the habitat characteristics selected by California spotted owls. Steger et al. (2002) compared adult survival between sequoia, oak and other conifer forest types and did find that owls with nests near sequoia groves did have somewhat higher survival. However, owls in the national park in other conifer types still had higher survival than owls on the national forest in other conifer. Oak woodlands supported lower survival on both the national park and national forest. These results suggest that differences in habitat type may explain some of the differences between the Park and national forest, but likely not all of the difference.

Several studies indicate that large blocks of undisturbed high quality habitat, such as found in the national park, support higher adult survival in spotted owls (Bart 1995, Franklin et al. 2000, Hunsaker et al. 2002), suggesting that differences in management partially explain differences in adult survival and population trend between Sequoia/Kings Canyon National Park and the Sierra National Forest. This conclusion is supported by Franklin et al. (2004) who stated:

> "Although sequoia groves may have provided a positive influence on apparent survival rates, we suspect that the disparity in apparent survival rates between SKC and the other three study areas in the Sierra Nevada was also influenced by different rates of timber harvest."

And by Verner (1999), who states:

> "Although none of these differences is significantly different [differences in adult survival have since been found to be significant, Franklin et al. 2004], the general results are consistent with those of Alan Franklin (In press) from his demographic study of the northern spotted owl on the Willow Creek site in the Klamath National Forest. Alan found that with access to larger blocks of suitable habitat owls had slightly lower mortality rates, but those whose home ranges were more patchy had slightly higher fecundity."

These conclusions support a hypothesis that Forest Service logging programs past and present are implicated in likely declines of California spotted owls on the Sierra National Forest.

Central Sierra Nevada Demography Study Area. Gutiérrez et al. (2003) studied a population of owls on the Eldorado and Tahoe National Forests in the central Sierra Nevada for 17 years (1986-2002), including identification of 1,149 individuals. Their estimate of λ_{PM} was 0.948 from 1990-1999 and was significantly different from a stationary population (z =2.048, p=0.02; Seamans et al. 2001). This value indicates a 5.2% annual decline from 1990-1999 (Seamans et al. 2001).

Gutiérrez et al. (2001) provide further support for a declining population on the Eldorado, finding that empirically estimated abundance on the Eldorado declined by 4.9% per year from 1993-2000.

More recently, Gutiérrez et al. (2003) used the Pradel method to estimate population trend, finding a λ_t of 1.025 (95% CI = 0.945-1.105) for 1992-2001, suggesting a stationary population. Gutiérrez et al. (2003) further note, however, that a negative trend in λ_t showed a negative linear trend over time, suggesting an "accelerating decline in population rate of change."

On differences between population trajectories using the two different methods, Franklin et al. (2004) concludes:

> "Although the confidence intervals overlapped for those two estimates of λ, they indicated different population trajectories; λ_t, a stable or increasing population, and λ_{pm}, a declining population… the difference occurred because either the two methods did not share the same inferences, or, that one or both were biased."

As discussed above, an important source of bias in λ_t is the lack of separation between within population recruitment and immigration (Franklin et al. 2004). Because of extensive and ongoing habitat loss in and around the Eldorado Study Area on private lands, this could pose a significant problem for estimating population trend using λ_t because owls may be immigrating to the study area masking potential declines. Franklin et al. (2004) discuss this issue at length:

> "Changes in habitat quality on the ELD may also have affected λ_t and were of greater concern because they may have long-term effects on vital rates. Two apparent causes of habitat loss during the study were logging and wildfire. There were two catastrophic wildfires that occurred during our study, the 1992 Cleveland Fire and the 2001 Star Fire, which burned all or part of six owl territories. Although the Cleveland Fire was adjacent to the ELD in what would later become part of the Regional Study Area, that large wildfire may have displaced individual owls that subsequently immigrated to the ELD. It was too early to determine the effect of the Star Fire on the population. The ELD was unique among the study areas because it was a mosaic ("checkerboard") of public and private ownership. That pattern was a relic of land allocation to the Central Pacific Railroad in the late 1800s. Most of the land has since passed to individuals or corporations and has been managed primarily for timber production. Although both public and private lands were harvested on the ELD, private land harvest rates were probably higher than on adjacent public land during the study because of application of CASPO guidelines. Timber harvest on the ELD may have affected territorial owls by reducing suitable habitat for roosting, foraging, or nesting."

These conclusions are supported by Bias and Gutiérrez (1992), who showed that within the ELD study area, owls almost exclusively relied

on Forest Service lands for nesting and roosting, primarily because private forestlands had fewer stands with attributes required by owls, including large trees, high canopy closure and large numbers of snags. It is a distinct possibility that extensive logging of private lands in and around the study area in combination with fires masked a decline of California spotted owls using the Pradel method by pushing owls onto federal lands within the study area.

Between estimated declines based on λ_{pm} and empirical abundance, a declining trend in λ_t, concerns that λ_t may be positively biased by immigration, and ongoing habitat loss in the central Sierra, there is cause for substantial concern for the Eldorado population of California spotted owls.

The San Bernardino Mountains Study Area. A demography study of owls in the San Bernardino Mountains began in 1987, was expanded to include the whole range in 1989 and was terminated after 1998 due to lack of funding. This range harbors the largest population in southern California with a total of 148 historic sites documented since the study began (LaHaye et al. 1999 and 2003). Because the San Bernardino population is insular, researchers have been able to monitor the entire mountain range from year to year. In addition, most owls in both the San Bernardino and adjacent Mount San Jacinto (11 air miles distance) were banded between 1988-1992. During this time, no owls were found to move between ranges, suggesting that estimates of both juvenile and adult survival are likely not biased by emigration from the study area. Franklin et al. (2004) acknowledge this fact, stating:

> "Estimates of apparent survival were likely unbiased estimates of true survival for the SAB. Insular populations of spotted owls in southern California were restricted to the higher elevations of the larger mountain ranges because desert and shrub environments dominated lower elevations in the region. Consequently, those owl populations were relatively isolated from one another, and intermountain movements (i.e. inter-population movements) were rare."

The lack of inter-population movement means that the San Bernardino population functions as nearly a closed population and that estimates of apparent survival used to estimate λ_{pm} are likely not biased by emigration. Franklin et al. (2004) acknowledge this as well:

> "Although estimates of population change based on λ_{pm} contained an unknown amount of bias in many spotted owl studies, λ_{pm} may have been appropriate for the SAB because of the insular nature of the study area."

In 1998, owls were found at 81 sites with 51 vacant (LaHaye et al. 1999). For the 12 years of study (1987-1998), mean apparent survival was 0.796, 0.880, 0.692, and 0.368 for adult, second-year subadult, first-year subadult, and juvenile (first year) owls, respectively (LaHaye et al. In press). The finite rate of population change (λ_{pm}) was 0.909 (SE = 0.018, 95% CI = 0.873 - 0.945), indicating that the owl population has declined by 9% annually (LaHaye et al. In press). A declining owl population is supported by declines in real numbers of owls. LaHaye et al. (1999) conclude:

> "Over the course of the study, the total number of vacancies created by turnovers was nearly twice the number of vacancies filled by replacements. These numbers were consistent with the hypothesis that the spotted owl population in the San Bernardino Mountains was declining."

Zimmerman et al. (2003) determined that overall occupancy of territories declined from 89% in 1989 to approximately 50% in 1998.

Although the San Bernardino demography study was terminated after 1998, LaHaye (2003a) surveyed a portion of all territories in both the

San Bernardino and San Jacinto Mountains under contract for the San Bernardino population. Estimates of owl vital rates were not calculated from this survey. Instead, territory occupancy and reproductive status were monitored. Based on these surveys, LaHaye (2003a) concludes: "occupancy rates of Spotted Owl territories appears to be relatively low in both mountain ranges." In the San Bernardino Mountains, occupancy was confirmed at only 35 sites, which is less than half of known sites and down slightly from 1998 when surveys were last conducted. Of the 21 sites in the San Jacinto Mountains, only about 20%, or six sites, were occupied, leading LaHaye (2003a) to conclude:

> "The occupancy rate of Spotted Owl territories in the San Jacinto Mountains is very low and cause for concern… Occupancy of such a low number of sites leads to a chance that Spotted Owls may disappear from the mountain range requiring recolonization from adjacent mountain ranges in order to reestablish this owl population. Unfortunately, movement of Spotted Owls between mountain ranges in southern California appears to be low."

LaHaye (2003b) further states that real numbers of territories and territory occupancy both declined during the study:

> "Twenty-one more territories were surveyed in 1998 than 1990 and we found 22 fewer owls (109 vs 87). Assuming that all 21 new territories existed (i.e. were occupied) in 1990 (and my gut feeling is that most did exist) and they were occupied at the same rate as the 127 territories in 1990 (80%), this population declined by 30-40% in 8 years. In addition, the territory occupancy rate declined from 80% to 56%. Thus, I have no doubt that the San Bernardino Mountain's spotted owl population declined during the study. The question is, what is the magnitude of this decline."

LaHaye (2003a) concludes that the reduction in owl occupancy may be a permanent result of loss of habitat due to drought, disease and fire:

> "The current drought and associated beetle infestation is leading to extensive deforestation in these mountain ranges. Additionally, dead trees and extended periods of dry weather increase the probability of large, stand-replacing wildfires. The combination of all of these potential impacts is likely to reduce the area of forested habitat in this region. Thus, there may be a substantial reduction in area of suitable Spotted Owl habitat leading to a permanent reduction in Spotted Owl numbers regionally."

Franklin et al. (2004) estimated λ_t of 0.978 (95% CI = 0.929-1.026), indicating a statistically uncertain decline. Given the above conclusions that λ_{pm} is likely not biased by emigration, it is difficult to determine a cause for the discrepancy in the two estimates. Franklin et al. (2004) provide several different theories:

> "The different population trajectories indicated by λ_{pm} from LaHaye et al. (1999) and λ_t in this meta-analysis may have been due to (1) a decline in the SAB population between 1988 and 1992 that was not captured by estimation of λ_t in our meta-analysis; (2) recruitment of floaters that were present prior to the study's initiation, such that territorial birds were being replaced, but females were not replacing themselves; (3) bias in one or more of the components of λ_{pm}; or (4) a violation of the assumption of constant vital rates during the study period when estimating λ_{pm}."

Regardless of the cause of the discrepancy, Franklin et al. (2004) ultimately conclude that there is cause for concern for the population in the San Bernardino Mountains:

> "concern may still be warranted for that population because (1) the estimate of apparent survival was lower than reported

for declining northern spotted owl populations, (2) the point estimate of λ_t was <1.0, and (3) the model for λ_t indicated a negative linear trend."

In summary, low apparent survival, low occupancy, a decline in territory occupancy rate, and strong indication of a declining population from both λ_t and λ_{pm} all suggest substantial concern for the California spotted owl in southern California.

C. Meta-analysis of the demography of the California spotted owl.

Based on a request from the Sierra Nevada Framework Project Team, a meta-analysis of the California spotted owl was conducted by a team of agency, industry and academic biologists, using data from all five study areas (Franklin et al. 2004). The team used *a priori* developed models and rigorous protocols for model selection to estimate apparent survival, fecundity and population trend (λ_t). Much of the results from the meta-analysis were discussed above. The following discussion focuses on the general results and conclusions of Franklin et al. (2004).

Franklin et al. (2004) determined that adult apparent survival was similar for all study areas, except Sequoia/Kings Canyon National Park. The pooled estimate of apparent survival for the four study areas (LAS, ELD, SIE and SAB, 0.819, 95% CI = 0.802-0.835) was significantly lower than estimated apparent survival for Sequoia/Kings Canyon National Park (0.877, 95% CI = 0.842-0.905) and lower than the mean estimate for northern spotted owls on 15 study areas (0.850, Franklin et al. 1999). This is significant because the owl's life history is based on a bet hedging strategy, where low and temporally variable fecundity is compensated for by a long reproductive lifespan (Franklin et al. 2004, Noon and Biles 1990, Noon et al. 1992). Noon et al. (1992) conclude:

> "The life history pattern of the spotted owl suggests that it must have evolved in an environment stable with respect to adult survivorship. The much greater sensitivity of λ to variation in adult than preadult survival rates indicates strong natural selection to maintain low adult mortality rates. Further, the low fecundity rate suggests that recruitment may always have been variable. In spite of this, high adult survivorship has allowed the spotted owl to persist through long periods of low reproductive output. A consequence of this trade-off is of great concern when considering management for spotted owls. Namely, low fecundity precludes rapid recovery from a population decline. Any management action that lowers adult survival rate, particularly when coupled with a reduction in population size, markedly increases the likelihood of local extinction."

Observed low adult apparent survival is thus of serious concern for the California spotted owl and strongly indicates the subspecies is at risk of population declines which could lead to extinction now or in the foreseeable future.

The best model for estimating population trend included different estimates for each study area (Franklin et al. 2004). Mean estimates of population trend indicated all of the study areas, except the Eldorado, had λ_t<1.0, although none of the declines were statistically significant. It is important to note that Franklin et al. (2004) do not conclude that a lack of a statistically certain decline is cause for lack of concern. Rather, they state:

> "Mean estimates of λ_t from all study areas were <1.0 except for the ELD. However, 95% CI for all estimates included 1, indicating that all of the populations were stationary or the estimates of λ_t were not sufficiently precise to detect declines if they occurred. That latter point was important because point estimates for four of the five study areas indicated annual population declines of 2-4% but

> the estimates were not sufficiently precise to differentiate those estimates from stationary populations."

Franklin et al. (2004) concluded the strongest evidence for decline was on the Sierra National Forest study area, that the best evidence for a stationary population was on the national park study area, and that the three other study areas were difficult to classify, although they note that the San Bernardino Mountain study area "had both low estimates of λ and low adult apparent survival." Based on these results, they conclude that their results support a scenario in which "spotted owls declined within a portion of the studies and appeared stationary in some of the studies." Decline at least on the Sierra National Forest, in combination with observed low apparent survival and differences in survival on the national forests compared to the national park indicate substantial cause for concern for California spotted owl populations.

D. The U.S. Fish and Wildlife Service's misuse of scientific uncertainty

In concluding that the California spotted owl did not warrant listing, the U.S. Fish and Wildlife Service applied a singularly narrow focus on the statistical uncertainty around estimates of λ_t, repeatedly stating "we cannot conclude with certainty that the population is declining, increasing, or stationary." Reliance on uncertainty ultimately forms a primary justification for Fish and Wildlife's conclusion that the owl did not warrant listing, stating:

> "Despite well-founded concerns regarding the current status of the subspecies, there are several factors that suggest that the California spotted owl is not in immediate danger of extinction nor will be in the foreseeable future. These factors include: (1) The subspecies remains widespread and well-distributed throughout its historic range, despite extensive historical effects on habitat and apparent sub-optimal conditions in current habitat; (2) The estimated numbers of the subspecies combined with its wide distribution reduce the likelihood of widespread extirpation due to a catastrophic event; and (3) *Although there are analyses that suggest populations may be declining, the population declines are not conclusively demonstrable."*

Besides running counter to the law, this over-reliance on uncertainty was heavily criticized by a number of the primary owl researchers and the agency's own biologists. Franklin et al. (2004), for example, conclude:

> "The USFWS issued a 12 month finding on 14 February 2003, not to list the owl. We believe it is important that such conservation assessments on the status of the owl be based on all the relevant data. We also believe that all the demographic evidence available—such as estimated vital rates, rates of population change, and differences between paired studies—suggest substantial caution in owl conservation and management efforts."

More pointedly, Guthrie Zimmerman, in comments solicited by the USFWS on a demography synopsis that formed the basis of their conclusions on the status of the owl, argues that the agency was biased in its reliance on raw numbers and λ_t:

> "I agree that multiple lines of evidence are the best approach to assessing population trends. However, you appear to put more emphasis on raw numbers than on estimates of vital rates. Emigration can bias estimates of lambda. However, Noon and Biles (1990) demonstrated that lambda is more sensitive to adult survival than juvenile survival and fecundity.

> Estimates of survival for territorial owls will likely have little bias if any at all because territorial owls rarely change territories. Raw numbers can be misleading, which is why modern analysis techniques are so concerned about estimating recapture and detection rates… Further estimates of lambda using the reparameterized CJS (Pradel models) have biases too. For example, the Pradel models address whether territorial birds are being replaced, rather than addressing whether territorial birds are replacing themselves. Therefore, the Pradel models could show a stable population for an area that is serving as a population sink. Overall, I see problems and biases associated with any method that is employed. Thus, I think it is a mistake to discredit results from lambda based on a projection matrix and focus on raw counts, estimates of population size, or the Pradel models… Overall, I think the report lacks objectivity."

Similarly, Blakesley and Noon (2003) criticized the synopsis for relying too heavily on analysis of λ_t from the meta-analysis and suggested that USFWS also discuss peer-review of the meta-analysis, which concluded that other metrics should be used. They state:

> "Because the synopsis incorporates the draft report from the meta-analysis, we feel that the USFWS should also consider recent reviews of the draft report by members of the AOU Conservation Committee: Jeffrey Walters, Evan Cooch, and Kenneth H. Pollack (December 2002). As summarized by the AOU, 'None of the reviewers felt that λ_t was entirely sufficient to characterize population change, and all indicated the report could be substantially improved by addition of data on two alternative metrics, a matrix-based approach of λ (λ_{pm}) and population counts.'"

These conclusions are echoed by Lahaye (2003b) who states:

> "Please understand that I am well aware of the limitations of lambda PM and think that the USFWS would be remiss in not sharing these problems with the potential readers of this document. However, I think this topic should be handled by discussing the strengths and weaknesses of each method and not discrediting one or more of the techniques."

USFWS' over-reliance on statistical uncertainty was also criticized by Dr. Alan Franklin, lead author of the meta-analysis, who states in comments on the USFWS synopsis:

> "I had one major concern with respect to the last sentence of the last paragraph of the document: 'At this time, we have no clear statistical evidence to show that the California spotted owl is declining throughout its range using either the projection matrix approach or Pradel's method." I thought this sentence was incomplete and, in being incomplete, may be misleading… First, adult survival is substantially lower for the owl populations on the national forest study areas than in the national park study area. In Franklin et al. (2000), we argued that adult survival sets the baseline for λ because it usually exhibits little temporal variation… Thus, factors that affect adult survival will directly affect rates of population change by raising or lowering the baseline for λ. Therefore, when I see this disparity in adult survival rates, most of which are also lower than those for northern spotted owls, then I become concerned that there may be a problem here. I am not sure that there

is a problem, but it makes me very cautious about whether these populations are indeed declining and we just do not have the ability to detect that decline because of the lack of precision in our estimates of λ. Second, the contrast between the paired SIE (national forest) and SKC (national par) study areas should be of some concern because of the differences in adult survival, trends in λ_t, and trends in fecundity. There appears to be some real differences between these two study areas, one of which is managed more intensively (SIE) than the other (SKC). Thus, your statement is partially correct in that there is no clear statistical evidence of declines in California spotted owls across their range, but there is evidence that there may be declines in certain populations. This was a similar result to what we found with the last meta-analysis of the northern spotted owl data."

Similar concerns were expressed by Kurt Johnson, a U.S. Fish and Wildlife Service biologist, in comments on the USFWS synopsis of owl status. Commenting on the USFWS' conclusion that information for the Lassen Study Area does not conclusively show declines, Johnson (2003) states:

> "Thus, for all three measures, the results show a declining population, but this is not deemed conclusive, even though the researcher has suggested 'that additional analysis has provided further confirmation of the suspected decline in the Lassen population.' The Service dismisses this because it does not 'have enough information to evaluate the statement at this time.' The Service's inconclusive conclusion does not seem to be precautionary in regard to this study (i.e. giving the benefit of the doubt to the species). It may be years before the conclusion is certain, and only if the project is allowed to continue (i.e. funding is continued). By the time a conclusion is definitive, it may be too late."

Johnson (2003) concludes:

> "My interpretation of these study results is:
>
> Lassen Study Area – weak decline
> Eldorado Study Area – weak decline
> Sierra Study Area – decline
> Sequoia and Kings Canyon Study Area – stationary
> San Bernardino Study Area – weak decline
>
> However, the Service says that the results are not conclusive enough to determine any rangewide trend… My feeling is that in cases such as the CSO, the benefit of the doubt should be given to the species. This is what I call a precautionary approach. In my opinion, the CSO is not an abundant species, is likely declining, and is certainly in trouble in southern California."

In sum, the USFWS failed to rely on the best available science by misusing scientific uncertainty related to California spotted owl population declines to conclude that the owl does not need protection.

E. The California spotted owl's status is comparable to or worse than the status of the northern or Mexican spotted owls when they were listed.

A review of the final rules listing the northern and Mexican subspecies shows that both were listed as threatened based on similar conditions as now exist for the California spotted owl. Like the California spotted owl, the two subspecies require stand characteristics associated with old growth forest, including large trees, high canopy closure, multi-layered stands and large numbers of snags. Neither was

listed because it was absent from large portions of its historic range. Indeed, both subspecies were thought to have a present range mostly identical to their past ranges, according to the final rules. Instead, they were listed because of habitat loss within their range caused by logging that was ongoing at the time of listing. Similarly, the California spotted owl is thought to occupy most of its former range, but has lost considerable habitat within that range to past and present logging. At the time of listing it was estimated the northern spotted owl had lost 60% of its former habitat within its range and when the Mexican spotted owl was listed there were no reliable estimates of habitat loss, but it was thought to have been considerable. As noted above, the California spotted owl has also lost a significant amount of habitat, including likely most of 2.4 million acres of potential habitat on private lands (Bias and Gutiérrez 1992 and Gould unpublished). On Federal lands, old growth forests are believed to have declined by approximately 70-80% (Beardsley et al. 1999, WGSCLS 1996), which indicates similar or potentially greater declines in habitat than experienced by the northern spotted owl.

The final rule for the northern spotted owl identified clearcut logging as the primary cause of habitat loss in the Northwest. Conversely, shelterwood cutting and thinning were identified as the main causes of habitat loss for the Mexican spotted owl. The California spotted owl is threatened by the latter, like the Mexican spotted owl. Though the two types of logging differ considerably, the eventual outcome is the same—replacement of older forests with younger ones less suitable to the owl. Verner et al. (1992) state:

> "Clearcut, seed-tree, and shelterwood cutting techniques all have the same goal: produce even-aged stands. In this regard, seed-tree and shelterwood systems can generally be thought of as two-stage (sometimes three-stage) clearcuts"… "In terms of owl biology, the primary impact of traditional, even aged harvesting practices lies in the creation of simple stand structures and, probably more importantly, the removal of all large trees from vast areas of the forest."

Salvage logging and thinning were and are the predominant prescribed cutting methods under the Interim Guidelines and the revised Framework (see below). These prescriptions will result in simple stand structures, lacking the necessary snags, multiple canopy layers and canopy closure to support California spotted owls. Thus, like the northern and Mexican subspecies, the California spotted owl is threatened with continued loss of an already much-reduced habitat base.

California spotted owl declines are as reliably documented as was the case for the northern and Mexican spotted owls. In fact, the rule listing the Mexican spotted owl did not even cite demography studies as a justification and instead relied entirely on present and predicted loss of habitat. The rule listing the northern spotted owl relied on two studies covering a small portion of the subspecies range and showing significant declines using λ_{pm}. Like the northern spotted owl, declines are reliably indicated in portions of the California spotted owl's range, in particular the Sierra National Forest and likely southern California and the Lassen National Forest (Franklin et al. 2004, Blakesley et al. 2001).

F. Conclusions

The California spotted owl has the smallest range of any of the three subspecies and has an estimated population less than 2,000 birds, which is not a large population. Within this range, it has experienced and is experiencing a significant diminution of its habitat, primarily due to logging. Such habitat loss has resulted in several breaks in its range in the Sierra Nevada that are of concern.

Considering the suite of information available on the status and threats to the California spotted owl, listing is warranted regardless of

whether either or both method is used to calculate population trend. Although Franklin et al. (2004) did not find statistically certain declines using the Pradel method, there are several factors that cause concern: 1.) both the Pradel and Leslie Projection Matrix methods strongly suggested that owl populations on the Sierra study area are declining; 2.) point estimates of λ_t less than 1 for all study areas except the Eldorado using the Pradel method; 3.) Leslie Projection Matrix Models consistently found significant declines across the other study areas, suggesting that owls are not producing sufficient young to sustain themselves and strongly suggesting that owl populations are declining on the Lassen and San Bernardino study areas, where it is unlikely that bias in estimates of juvenile survival is sufficient to mask stable populations; 4.) apparent adult survival in all national forest study areas is lower than both the national park study area, where timber harvest is prohibited, and the average apparent survival of northern spotted owls, which are known to be declining; and 5.) key components of spotted owl habitat, such as large trees and stands with dense multi-layered canopies, are at historical lows and continued logging threatens to further reduce habitat. These concerns demonstrate the California spotted owl warrants listing as a threatened or endangered species with or without use of Leslie Projection Matrix models.

V. Present or threatened destruction, modification, or curtailment of the California spotted owl's habitat or range

A. Logging in the Sierra Nevada

Logging in the Sierra Nevada has resulted and is continuing to result in loss of key components of spotted owl habitat over large portions of the landscape. Specifically, logging has resulted in the loss of large trees, snags, multi-layered canopies and a reduction in canopy closure, all defining characteristics of both quality owl habitat and old growth condition (Beardsley et al. 1999, Bias and Gutiérrez 1992, Gutiérrez 1994, McKelvey and Johnston 1992, Verner et al. 1992). Loss of these components from Sierra Nevada forests has resulted in a drastic decline in nesting, roosting and foraging habitat of the spotted owl (Bias and Gutiérrez 1992, Moen and Gutiérrez 1997). The following paragraphs discuss the history, extent and effect on the California spotted owl of over a century of logging in the Sierra Nevada.

Historic extent and method of logging in the Sierra Nevada. Logging in the Sierra Nevada began with the onset of the California Goldrush in 1849, but until early in the twentieth century was mostly limited to areas surrounding mining and other towns, and major railroads (Beesley 1996, Leiberg 1902, McKelvey and Johnston 1992, Sudworth 1900). Beesley (1996), for example, states:

> "Logging before 1900 affected many parts of the Sierra Nevada. This industry developed primarily in support of mining activities near newly created camps and towns located on the western and eastern slopes on the northern and central portions of the range."

Though limited in extent, a number of areas were heavily logged prior to the turn of the century, particularly the Tahoe-Truckee Basin and other parts of the northern and central Sierra Nevada. McKelvey and Johnston (1992) state:

> "In particular, areas north of Nevada City and the Truckee Basin were heavily cut. Again, access was key and the presence of the Southern Pacific Railroad allowed transportation to more distant markets. Lake Tahoe also provided convenient access, allowing large quantities of timber to be taken from areas adjacent to the lake. In addition, a 4 mile wide strip following the railroad between Reno and Sacramento was heavily logged for locomotive fuel."

Logging occurred in both the American and Yuba River Basins, and in portions of Nevada, Sierra, Placer and Mariposa Counties (Beesley 1996, Leiberg 1902, McKelvey and Johnston 1992, Sudworth 1900). Leiberg (1902) documented that in the northern Sierra Nevada, including portions of what are now the Tahoe, Eldorado and Plumas National Forests and the Lake Tahoe Basin Management Unit, a total of 1,386,890 acres had been cut for milling and mine timber, leaving 2,337,930 acres uncut. Of these, the Tahoe was the most heavily impacted prior to 1900, with about 50% of the Forest entered for logging (Leiberg 1902, McKelvey and Johnston 1992).

Early logging practices ranged from complete removal to light high grading. Leiberg (1902) noted that anywhere from five to 99% of the stand was removed. Heavy timber removal was for the most part restricted to low elevations, near rail lines, such as the Southern Pacific Railroad, and areas surrounding mines and mills (Beesley 1996, Leiberg 1902, McKelvey and Johnston 1992, Sudworth 1900). Sudworth (1900) reported that "a common practice of mill operators is to consume all saw timber in a radius from the plant of from 2.5 to 3 miles, and then move to another site." Culling of large trees occurred in a wider area, including low and mid elevations throughout the northern and central Sierra. Large sugar pine were particularly sought after for the shake market, but yellow pine were also heavily cut. Beesley (1996) summarized:

> "The reproduction of certain species such as sugar pine was reported to be imperiled by the wasteful high grading practices of shake makers who took only the best parts of the large trees, leaving the rest as waste. Yellow pines were reported to have been taken in great numbers, especially in areas adjacent to mining operations, and brush and other noncommercial plant species were reported to be replacing them (Sudworth 1900; Leiberg 1902)."

Though primarily sugar and yellow pine were cut, Sudworth (1900) reported that "in some localities, however, 25 to 40 per cent of the cut consists of white fir, red fir, sugar pine and Jeffrey pine."

In sum, logging before the turn of the century began the process of removing and reducing large trees and stand structural complexity from the landscape, but was primarily limited to the northern Sierra at low elevations and near mines, mills and rail-lines. Though we have no way of knowing the direct effects of early logging on the California spotted owl, a reasonable hypothesis is that some areas formerly serving as owl habitat were made unsuitable and others were degraded.

The period from 1900 to 1940 saw both the formation of National Forests in 1907 and a major expansion in logging, particularly on private lands. The Southern Pacific Railroad facilitated the shipment of lumber from the Sierra Nevada to distant markets. This fact combined with new railroad logging techniques led to large increases in logging. Beesley (1996) states:

> "Much of the most accessible Sierran timberland by 1900 was in private hands. Application of railroad logging techniques permitted greater amounts of lumber to be brought to market and allowed more distant areas to be logged economically… The railroad lumber industry of the Sierra Nevada grew most between 1890 and the 1920s, and more than eighty rail logging companies were created. Logging rail systems opened formerly inaccessible privately held timberlands to intense development until the 1930s."

Similar to before the turn of the century, logging was concentrated in the northern and central Sierra, primarily affecting areas within and near the Eldorado and Stanislaus National Forests, and the Tahoe-Truckee Basin and South Yuba River drainage. In the southern Sierra, logging

still primarily served local markets, affecting areas near the Sequoia National Forest and elsewhere (Beesley 1996). Beesley (1996) reports that:

> "By 1934 more than half of the mixed conifer forestland in the north-central Sierra Nevada had been entered for harvesting, although logging was restricted primarily to ponderosa, Jeffrey, and sugar pines."

Private lands, in particular, were heavily impacted by logging prior to 1940 with more than 90% of remaining pristine stands occurring on federal lands (Beesley 1996). Cutting during this period primarily focused on taking the largest sugar and yellow pines, often resulting in complete removal of large trees of these species from stands. Beesley (1996), for example, concludes:

> "A report issued by S.B. Show for the Forest Service in 1926 warned that if the pine forestland in California, 80% of which was in private hands, continued to be cut at currently existing cutting rates, most of the companies involved would soon be in the cut-over land business… The most significant effect of logging before 1940 was the removal of the largest yellow and sugar pines."

Overall, the period from the turn of the century to the start of World War II saw a major increase in logging. Harvest on lands in the Sierra Nevada increased from below .4 billion board feet in 1900 to over 1.2 billion board feet in the late 1920s (McKelvey and Johnston 1992). During the Great Depression, harvest levels dropped sharply, but only until the start of WWII when they increased dramatically (Beesley 1996, McKelvey and Johnston 1992). Again, we have no direct data on the effects of this increased logging on the California spotted owl, but given that it focused on the largest trees and covered fairly extensive portions of the landscape, a reasonable hypothesis is that logging prior to 1940 contributed to a declining trend in the amount and quality of owl habitat.

During and after World War II, logging in the Sierra Nevada grew at a nearly exponential rate (Beesley 1996, McKelvey and Johnston 1992), fueled by increased demand for lumber and facilitated by new technologies, including the chainsaw, the tractor and later cable logging systems (Hirt 1994). McKelvey and Johnston (1992) report that logging increased from nearly 1.2 billion board feet in1940 to over 1.8 billion board feet in the mid 1950s. Logging levels declined to around 1.4 billion board feet in the late 1950s, remaining fairly constant until a brief decline during the 1982 recession, after which they rose sharply to nearly 1.8 billion board feet in 1990 (McKelvey and Johnston 1992). Beesley (1996) concluded that the Forest Service had "moved from a custodial role into a production mode," further stating:

> "As an example, between 1902 and 1940, the total timber harvested on the Eldorado National Forest was 148.9 million board feet. From 1941 to 1945 it totaled 175.4 million board feet, reflecting wartime demand. Between 1946 and 1956, the harvest total stood at 728.9 million board feet, meaning that in thirteen years more than twice as much timber was harvested on the Eldorado than in the preceding forty-three years."

In order to carry out this immense increase in logging, Beesley (1996) states that "both public and private forestry in the postwar period moved toward 'intensive timber management practices' ". Logging practices shifted to either heavy selection for most or all large trees in a stand or even aged practices, such as shelterwood, overstory removal, seed tree, and clearcutting (Helms and Tappeiner 1996). On Forest Service lands, clearcutting was rarely used prior to 1970, when there was a policy shift emphasizing this practice (McKelvey and Johnston 1992). Because of this shift, clearcutting was common on Forest Service

lands throughout the 1980s and accounted for most of the volume harvested from 1983 to 1987 (Ibid.). Regardless of logging method, however, the effects were often very similar, Verner et al. (1992) conclude:

> "Clearcut, seed-tree, and shelterwood cutting techniques all have the same goal: produce even-aged stands. In this regard seed-tree and shelterwood systems can generally be thought of as two-stage (sometimes three-stage) clearcuts. In all of these cutting systems, the original stand will be totally removed before the new stand is scheduled to be cut."

Similarly, on past selective cutting, Verner et al. (1992) conclude:

> " 'Selective' harvest in the Sierra Nevada has, in the past, primarily targeted the large trees. This system sometimes called 'pick and pluck,' will not produce the simple, even-aged structures that characterize clearcutting techniques, but its effect on the presence of large, old trees is similar."

On private lands, the California Forest Practices Act of 1943 emphasized seed tree logging as the preferred silvicultural method (Helms and Tappeiner 1996). Removal of most of the overstory was also encouraged by the state constitution, which gave a tax subsidy to landowners who harvested at least 70% of the volume on their land. Helms and Tappeiner (1996) state:

> "A major force shaping timber harvesting and regeneration on private lands in California was section 12 ¾ of the state constitution. This section enabled landowners who harvested at least 70% of the volume of trees on a unit of land to pay taxes only on the land, rather than on the land and timber, for forty years or until another harvest was made. This form of tax relief on private lands resulted in heavy selective cutting and discouraged more modest thinnings."

Both of these policies resulted in removal of most large trees from private lands during this period.

Forest practices were not only more intensive after 1940, but also were expanded to include all National Forests of the Sierra Nevada. This means that forests in the southern Sierra Nevada, which up until 1940 were relatively lightly harvested, now became major producers of timber. For example, annual timber production in Fresno County, in the southern Sierra, rose from roughly 37 million board feet in 1947 to a peak in 1975 of 136 million board feet (Bolsinger 1978). Additionally, areas previously unpractical to log were now under production. Beesley (1996) states "many of the areas opened had previously been considered too remote or steep to log."

Thus from 1940 through the early 1990s most mixed conifer and ponderosa pine forests of the Sierra Nevada on both public and private lands were utilized primarily for the production of lumber. This combined with previous logging has resulted in the loss and degradation of California spotted owl habitat across the majority of the Sierra Nevada.

Forest Condition prior to logging. By all accounts, the majority of mixed-conifer forests in the Sierra Nevada at the turn of the century were characterized by exceedingly large trees and a high degree of structural complexity (Franklin and Fites-Kaufmann 1996, Leiberg 1902, McKelvey and Johnston 1992, Sudworth 1900). Franklin and Fites-Kaufmann (1996), for example, state:

> "The collective inference from all lines of evidence is that stands with moderate to high levels of LS/OG [late successional / old growth]-related structural complexity occupied the majority of the commercial forestlands

> in the Sierra Nevada in presettlement times."

And McKelvey and Johnston (1992) conclude:

> "Stands described by Sudworth (1900) were very large and very old. The average yellow pine, for instance, was reportedly 150-180 feet tall, 3-4 feet in d.b.h., and 250-350 years old… Most stems exceeded 25 inches in d.b.h., and many extremely large specimens were measured. Of the major timber species, sugar pine, Douglas-fir, and white fir occurred only as very large trees."

Sudworth (1900) quantified the number, species and size of all trees over 11 inches diameter on 22 one-quarter acre plots, of which three were sub-alpine types and thus not of interest in relation to the owl. The average diameter of trees on the remaining 19 plots was 40.9 inches with the average diameter in individual plots ranging from 25.6 to 52.7 inches. Given the predominance of large trees in most Sierran stands, it is likely that there were also considerably more large snags and downed logs than exist on the present landscape (Franklin and Fites-Kaufman 1996).

Sudworth (1900) described presettlement forests in the Sierra Nevada as "open", but with areas of dense forest. Speaking of the "middle timber belt," Sudworth states:

> "As a rule the growth is continuous but rather open; there are, however, areas of considerable extent on broad benches where the forest is dense. The trees are usually of large dimensions.."

The average number of trees over 11 inches diameter in the 19 plots measured by Sudworth (1900) was 24 trees/quarter acre with individual plots ranging from 15 to 43 trees/quarter acre, indicating fairly dense stands. Considering the number and size of trees found in turn of the century Sierran forests as measured by Sudworth (1900) and that according to Beardsley et al. (1999) "the crowns of the species found in mixed conifer are generally broader, thereby resulting in dense canopy cover," it is likely that most presettlement Sierran mixed conifer forests had fairly high canopy closure, but were described as open because understory vegetation and tree regeneration were sparse or patchy.

There is no way to know the proportion of the presettlement forest landscape that was in an old growth condition, but based on descriptions it seems likely that it was the majority (Leiberg 1902, Sudworth 1900). WGLSCS (1996) determined that within the national parks high- and mid- quality old growth mixed conifer occupies approximately 90% of the forested area, further indicating most of the forested landscape was in an old growth condition prior to logging.

Extent of habitat loss and degradation from logging on Forest Service and private lands. Primarily because of logging, present day Sierran forests are drastically different from those described at the turn of the century. Perhaps most obvious is that forests once dominated by trees well over 25 inches diameter are now dominated by trees under 20 inches. McKelvey and Johnston (1992), for example, conclude:

> "A comparison of that distribution [Sudworth (1900)] with the largest diameter stands in Sierran forests of today shows that far more of the stand basal area in the forests of 1900 was concentrated in very large trees… To various degrees, the forest system has been changed from one dominated by large, old, widely spaced trees to one characterized by dense, fairly even-aged stands in which most of the larger trees are 80-100 years old."

Other changes include reduction and loss of large snags and logs and multi-layered canopies, reduced total canopy cover, and habitat

fragmentation. Franklin and Fites-Kaufmann (1996) conclude:

> "A logical inference from both the rankings and the tabulated characterizations of the patches developed in the mapping exercise is that large-diameter decadent trees and their derivatives—large snags and logs—are generally absent or at greatly reduced levels in accessible, unreserved forest areas throughout the Sierra Nevada. This reflects the selective removal of the large trees in past timber harvest programs as well as the removal of snags and logs to reduce forest fuels due to wildfire concerns. Snag removal programs have been underway on both public and private lands for over 60 years and log reduction programs have been underway for about half that period… Key structural features of LS/OG forests—such as large diameter trees, snags and logs—are generally at low levels… While forest continuity is high in the Sierra Nevada, as noted above, the forest structure has been greatly simplified relative to presettlement conditions so that these forests do not produce the same level of wildlife habitat and ecological functions, characteristic of high-quality LS/OG forests."

Overall declines in old growth forests have been substantial. Two studies have tried to determine the extent of these declines. Based on a comparison of 2,455 ground plots measured in 1991-1993 with data from a 1940s era mapping project, Beardsley et al. (1999) estimated old growth forests declined from 45% of the landscape in the mixed conifer, true fir and pine types to 11 % of the landscape between 1945 and 1993. Considered alone, however, mixed conifer old growth declined from 50% to 8% of the landscape, indicating old growth mixed conifer forests have declined by approximately 84% since 1945. Remaining old growth was found to occur primarily on federal lands, reflecting the substantial degradation of private lands. The authors state that by 1993:

> "Of the 4.8 million acres of mixed-conifer forests in the Sierra Nevada, 371 thousand acres (8 percent) were old growth. Almost all the old growth was in Federal ownership, mostly National Forests and National Parks. Surprisingly, most of the old growth in National Forests was outside designated wildernesses. Less than 2 percent of the 3 million acres of privately owned coniferous forests was old growth."

Beardsley et al. (1999) note that though many stands do not qualify as old growth, they have one or more large trees. Presumably a portion of these stands provide nesting and roosting habitat for the owl. Even these stands, however, are highly limited. The study found only eight percent of the landscape is occupied by stands with three or more trees greater than 40" dbh and only 21% of the landscape was found to have one or more trees greater than 40" dbh. Such trees are documented to be a crucial part of owl nesting and roosting habitat (Moen and Gutiérrez 1992).

With similar results, the "Working Group on Late Successional Conservation Strategies" (1996) compared the amount of late-successional habitats (Ranks 4 and 5) in National Parks and National Forests in the Sierra Nevada to approximate decline and found that in the former, high quality late successional habitats occupy 67% of mixed conifer forests, compared to 12% in the latter, indicating a decline of 82%. Similarly, old growth red fir forests have declined by roughly 72%, old growth white fir and eastside mixed conifer forests have declined by 79%, and old growth eastside pine forests have declined by an astounding 99%. Further, much of the old growth remaining on national forests has been degraded by some selective cutting, occurs in less valuable timber types, such as red fir, or is

highly fragmented (Franklin and Fites-Kaufmann 1996).

Effects of habitat degradation and loss on the California spotted owl. Logging of Sierra Nevada forests has resulted in a drastic reduction in nesting, roosting, and foraging habitat across the landscape. This is based on studies demonstrating that spotted owls select stands with large trees, snags and downed logs, high canopy closure, and multi-layered canopies for nesting, roosting and foraging (Bias and Gutiérrez 1992, Call 1990, Gutiérrez et al. 1992, Laymon 1988, Moen and Gutiérrez 1997), and that stands with these attributes have declined substantially (Beardsley et al. 1999, Franklin and Fites-Kaufmann 1996, McKelvey and Johnston 1992). Verner et al. (1992) state:

> "Having concluded that California spotted owls are not habitat generalists, particularly for nest stands, we must determine whether any evidence indicates a decline in the amount of habitat used more than expected by the owl."

Clearly, such decline has occurred and indeed, Verner et al. (1992) conclude:

> "Are key habitat elements declining in the Sierra Nevada? Yes. Of greatest concern to us at this time is the rapid disappearance of the large, old, and generally decadent trees that are the focus of nesting by spotted owls."

Based on several lines of evidence, loss and degradation of habitat has likely resulted in reductions in owl density in parts of the Sierra Nevada. Two studies documented that owls were substantially reduced in degraded forests compared to similar, but less degraded, areas (Bias and Gutiérrez 1992, Gutiérrez et al. 1992). Bias and Gutiérrez (1992) found that 26 of 29 roost sites and 11 of 11 nest sites were on public lands in an area of checkerboard ownership, primarily because of the effects of greater amounts and intensity of logging on private lands. The authors state:

> "*Fewer ($P \leq 0.001$) owls were detected on private lands than expected from its relative land area [emphasis added]*. Slope; total canopy closure; number of possible nest trees; maximum shrub height; basal areas of old growth, medium, pole, and live trees; percent ground cover by litter; and small and large dead or dying woody vegetation were different ($P \leq .05$) between public and private land. Habitat types of mixed-conifer, large tree successional stage, with ≥70% total canopy closure were most abundant (38.1%) on public land; whereas mixed-conifer, pole-medium successional stage with ≥70% total canopy closure habitat types dominated private land (44.1%). Roost sites occurred in habitats with relatively greater canopy closure, and basal area of snags, medium and old growth trees than the abundance of habitat."

Similarly, Gutiérrez et al. (1992) documented that owl densities on USGS quadrangles were significantly correlated with the proportion of mixed conifer forests having medium sized and larger trees and high canopy closure, stating:

> "We interpreted these relations cautiously, however, because survey effort was not uniform among the survey units and error exists in the type of mapping of mixed-conifer habitat by the FS (Call 1990, Bias and Gutiérrez 1992, G.N. Steger pers. observ.). Nevertheless, this analysis suggested that, as with nest stands, owl densities were higher in areas with a higher proportion of dense stands and large trees."

Further, both our analysis of owl distribution and one of Beck and Gould (1992) show several areas where owl densities are low because of

loss of suitable habitat. In addition, several known historical owl sites have been decimated by logging and no longer exist. Gould (1977) states:

> "Logging and other forest cutting practices appear to be the major causes making forest habitat unsuitable for Spotted Owls. Two adjacent sites reported occupied in 1960 and 1961 were unoccupied in 1974. Since originally reported, both sites had been logged, removing approximately 80% of the canopy over 80% of the area around the sites. The destruction of habitat apparently caused the owls to abandon the territories. Habitat destruction, usually involving logging, was the major cause believed responsible for the absence of Spotted Owls at five historical sites checked." [At least two of these and possibly a third are in the range of the California subspecies.]

These few sites provide an example for perhaps hundreds of owl sites that have been decimated by logging, but were not visited prior to intensive logging.

There is also reason to believe that owl densities may be substantially reduced on private lands in the Sierra Nevada. In total, only 176 territories, of which 146 are considered reliably extant, have been documented on private lands in the Sierra Nevada (Gould unpublished data), despite the fact that such lands occupy 2.4 million acres of some of the most productive forestlands in the range (Verner et al. 1992). Though this is in part due to lack of survey, the findings of Bias and Gutiérrez (1992) combined with knowledge that private lands have been more intensively logged for a longer period of time and that only two percent of all private lands can be classified as old growth (Beardsley et al. 1999) suggests that large areas of private land may have been made unsuitable for the owl, thereby reducing owl densities and potentially resulting in loss of range.

Conversely, Verner et al. (1992) assert that the: "current distribution and abundance" of owls "do not suggest that they have declined either in their overall distribution in the Sierra Nevada or that they have declined markedly in abundance within any forest type," and add that "spotted owls may be more abundant in some areas of the Sierra Nevada today than they were 100 years ago." Although it is true that California spotted owls do occur over the length of the Sierra Nevada, without historical data this conclusion is highly speculative at best. First, given that there is very limited information about the historic or current distribution of spotted owls in eastside and Pacific ponderosa pine habitats, foothill riparian-oak habitats or on private lands in general and that these forests have been severely altered by logging and other factors (Beardsley et al. 1999, Franklin and Fites-Kaufmann 1996), there is a distinct possibility that owls have been eliminated from portions of these areas and thus it is premature to state that there has been no range contraction. Second, because spotted owls occur over the length of the Sierra Nevada does not mean that they have not declined in density. Indeed, evidence provided above suggests this has likely occurred. Finally, justification for the statement that spotted owls may have increased is supported by little to no data. This statement is based on a theory that rampant sheep grazing may have caused a decline in flying squirrel numbers, reducing owl populations, which have presumably now rebounded. The authors state:

> "Late last century, sheep and sheep herders so depleted the understory vegetation and the supply of dead-and-downed wood at some locations in the Sierra Nevada that flying squirrel populations may have been depressed. We would expect owl numbers to decline proportional to the decline in numbers of flying squirrels, unless the owls preyed mainly on other species in the latter part of last century."

The authors fail to provide any references or data for the above assertion and indeed, there is no data from the turn of the century on squirrel populations, or levels of dead-and-downed wood. There are historic accounts stating that sheepherders burned to remove dead wood (see McKelvey and Johnston 1992), but it is unknown how often or to what extent they burned and what effect this had on downed wood. Many early authors (e.g. Sudworth 1900 and Leiberg 1902) tended to underestimate the frequency of natural fires, believing that most fires were human caused. This fact combined with a recognized prejudice against sheepherders probably resulted in accounts of their burning being exaggerated (McKelvey and Johnston 1992, Vankat 1977). It is likely that sheep had a devastating effect on understory vegetation and that sheepherders did do some burning, but the effects of this on flying squirrel populations are unknown and the authors failed to cite a current study showing a relationship between grazing and flying squirrel populations. Thus the above assertion is based on several interrelated and complex hypotheses without supporting evidence. Even if it were true that owls declined because of sheep-herding, however, it would not indicate owl populations were secure, but instead suggests that they had recovered from the effects of grazing at the turn of the century. If such a hypothetical recovery occurred, we have no way of assessing the extent of recovery or whether continued impacts from logging and other factors had hampered it.

B. Current Logging on Federal Lands

Logging under the Interim Guidelines (1993-2001). From 1993-2001, logging on Forest Service lands was regulated under Interim Guidelines developed by a team of Forest Service, state and university biologists and presented in a report entitled *The California Spotted Owl: A Technical Assessment of Its Current Status* (Verner et al. 1992). In order to comprehensively analyze the effects of logging on the owl under these Guidelines, we requested through the Freedom of Information Act, all Biological Evaluations (BEs), Environmental Assessments (EAs) and other decision documents for Forest Service projects where the agency concluded "may affect individual owls, but *is not likely* to lead to a trend towards listing" or "may affect individual owls and *is likely* to lead to a trend towards listing" from 1990 to July 1998. Using this information, we tabulated the number and types of projects that potentially affected owls, and the number of instances in which owl territories, PACs or SOHAs were potentially impacted. A summary of this analysis follows. For a more detailed discussion, see our original petition to list the California spotted owl.

Table 11. Summary of effects on California spotted owls from Biological Evaluations on seven national forests from 1993-1998 under Interim Guidelines.

National Forest	BEs with "may affect"*	# of times PACs affected	# of times SOHAs affected	# of times owl sites affected	Total PACs/NF	Total SOHAs/NF
Lassen	54	66	48	6	85	40
Sierra	89**	131	8	32	200	29
Eldorado	143	598	75	70	168	31
Sequoia	21	8	6	23	106	40
Stanislaus	103	66	22	34	132	35
Tahoe	47**	44	16	5	106	33
Plumas	48	58	10	13	190	54
total	**505**	**971**	**185**	**183**	**987**	**262**

* Number of biological evaluations (BEs) that concluded Forest Service projects "may affect individual owls, but will not lead to a trend toward Federal listing."

** One determination of "likely to adversely affect the California spotted owl."

From 1993-1998, over 500 projects were conducted by the Forest Service that potentially impacted California spotted owl territories, area in 183 instances (Table 11). The majority of these projects were timber sales, but also included road construction, recreation projects, general construction and prescribed burns. Considered individually, almost none of these projects would lead to a trend towards listing, but the cumulative effect of these actions combined with the past effects of a century of logging has had widespread negative effects on owl habitat and owl populations, meriting its protection under the ESA. In sum, the Forest Service's own documents show that logging under the Interim Guidelines continued the degradation and destruction of owl habitat on federal lands.

Logging under the revised Sierra Nevada Framework and Quincy Library Group Pilot Project. In January 2001, the Forest Service adopted the Sierra Nevada Framework, a plan that contained substantial protection for the California spotted owl and old-forests in general. In particular, the Framework maintained 300-acre PACs for all previously and newly located owls, and established core areas ranging from 600-2,400 acres depending on location of the territory in the Sierra Nevada (includes 300 acres within PACs). Management activities within PACs and core areas, outside of the urban defense and threat zones[3] was limited to hand treatments, such as pruning, to reduce ladder fuels near nest trees, and prescribed fire. To protect old-forest ecosystems in general, the 2001 Framework placed roughly 40% of the landscape in old-forest emphasis areas in which fuels treatments were limited to prescribed fire and cutting trees under 12" diameter, protected all CWHR 5 or better stands larger than one including effects to PACs in 971 instances, to SOHAs in 185 instances and individual owl territories not identified with either management acre and prohibited cutting trees larger than 20" diameter in most Westside forests. The 2001 Framework also placed all of these restrictions on the Quincy Library Group Pilot Project in suitable habitat, sharply limiting its impact on the California spotted owl. Although these protections were a significant step forward, they were not without risk. The U.S. Fish and Wildlife Service in their biological opinion on the 2001 Framework expressed the greatest concern for owl habitat in the urban defense and threat zones and general forest, where cutting of trees 12-30" dbh and reductions of canopy closure of 20% or more can occur (USFWS 2001). The U.S. Fish and Wildlife Service, for example, concluded:

> "In the threat zone of the urban interface (32 percent of owl sites), and in areas outside of spotted owl core areas in the general forest outside of urban areas (presumably 15 percent of owl sites), the use of RX31 could degrade spotted owl habitat through the removal of trees and reduction of canopy cover. This prescription could be used to cut trees 12-20 inches dbh, which have been found to be important components of spotted owl habitat."

Despite the fact that protections provided by the 2001 Framework were recognized as entailing risks for the California spotted owl and just adequate to avoid listing the owl as a threatened or endangered species, the Forest Service issued a Record of Decision January 22, 2004 substantially weakening protections for the California spotted owl and its old forest habitats (USDA 2004a).

The 2004 Framework removes standards and guidelines restricting logging within old-forest emphasis areas, mature and old-growth stands (CWHR 5M, 5D and 6) >1 acre and California spotted owl home range core areas and replaces them with vague descriptions of desired future

[3] The defense zone comprises an area .25 miles around areas with high densities of anthropogenic structures, where intensive mechanical treatments are allowed to protect life and property. The threat zone extends 1.25 miles beyond the defense zone, where reductions of canopy closure >20% or below 50% and cutting of trees >20" diameter are prohibited, but reducing fire risk is a priority.

condition. Before revision, the Framework generally prohibited cutting trees >12" diameter and reductions of canopy closure greater than 10% or to below 50% in these land designations. Following revision of the Framework by contrast, there are no specific standards and guidelines for old-forest emphasis areas or mature and old-growth stands, and only a provision to retain 50% canopy closure in owl home range core areas where feasible, and 40% otherwise. Standards and guidelines for these supposedly protected designations are essentially no different than for general forest, which allow cutting live trees up to 30" diameter, reductions of canopy closure to 40%, and nearly unrestricted salvage logging of dead trees. Given numerous studies demonstrating that California spotted owls select stands with >70% canopy closure and more trees medium (>20" dbh) and large (>30"dbh) trees for nesting and roosting, and stands with >50% canopy closure and more medium and large trees, the 2004 Framework is likely to result in continued loss and degradation of owl habitat.

The Final Supplemental Environmental Impact Statement for the 2004 Framework largely corroborates that weakening of protections will result in further habitat loss for the California spotted owl. The FSEIS, for example, concludes that 3,624 more acres will be treated in California spotted owl PACs and HRCAs than would be under the 2001 FEIS. Incredibly, an additional 225,421 acres of old forest emphasis area would be logged under the 2004 FSEIS than under the 2001 FEIS. In the Quincy Library Group study area, 123,500 acres (8.7%) of all stands with >50% canopy cover would be reduced to 40% canopy cover. The FSEIS further notes that these reductions in habitat quality and outright loss of habitat entail additional risk for the owl. In particular, the FSEIS acknowledges that the 2004 Framework increases the risk of further habitat and population fragmentation in Areas of Concern identified by Beck and Gould (1992):

> "In the short-term, Alternative S2 increases risk of continued declines in owl density within areas of concern due to more intensive thinning based on application of the forest-wide standards and guidelines for mechanical treatments in mature forest stands and HRCAs. This increases the risk identified for widening gaps between habitat parcels, potentially resulting in reduced owl densities and reduction in distribution of owls and owl habitat in AOCs."

The FSEIS further acknowledges that the more intensive treatments prescribed under the 2004 Framework are more likely to degrade suitable owl habitat:

> "Mechanical thinning has a greater potential to reduce the canopy cover and structure more than light underburning. Because more acres are projected to be mechanically treated under Alternative S2, this alternative is likely to have a greater effect on stand structure (down logs, snags, canopy layering, duff layer and tree density) within treated areas."

Thus, even according to the Forest Service's own documentation, the 2004 Framework increases a risk of loss in viability for the California spotted owl by allowing further loss and degradation of suitable habitat.

The Sierra Nevada Forest Protection Campaign is actively involved in commenting on and appealing timber sales in the Sierra Nevada and has maintained a spreadsheet of all sales in planning since revision of the Framework. To date, there are 35 timber sales being planned or carried out, including treatment on 101, 816 acres and harvest on 54,689 acres, including over 6,700 acres of group selection cutting. In most cases, pre and post canopy cover levels are not described. In 11 cases, however, the Forest Service admits that canopy cover will be reduced below 50% and in only 1 case do they state that they will maintain 50% canopy cover. Fourteen of the projects will affect spotted owl "home range core areas" (HRCA), including five in which they admit they will reduce canopy cover below 50%. Five of the projects

occur in "areas of concern" for the owl and 1 occurs in a "protected activity center." Only two of the projects expressly stated that they will only cut trees <20" dbh and most will cut trees up to 30" diameter. These projects will result in further loss and degradation of California spotted owl habitat in addition to the extensive loss that has occurred over the last 100 years. Given the owls' poor adult survival, likely declines, relatively small population size and sensitivity to ongoing habitat loss, continued destruction and degradation of habitat can only exacerbate the owl's status, necessitating its listing as a threatened or endangered species under the Endangered Species Act.

The Quincy Library Group Pilot Project (QLG) will result in continued loss and destruction of habitat in the northern Sierra.

Based on the Herger-Feinstein Quincy Library Group Forest Recovery Act of October 12, 1998, the Forest Service proposed to implement a 5 year pilot project, including construction of up to 300,000 acres of defensible fuel profile zones and 43,000 acres of group selection and individual tree harvest. The Record of Decision and Final Environmental Impact Statement (FEIS) for the QLG (USDA 1999a and b) both recognized that logging under the project would have severe impacts to the owl and its habitat. The FEIS recognized that DFPZs and group selection would further degrade and fragment habitat, including further loss of habitat within two areas of concern identified by Beck and Gould (1992)(USDA 1999b). USDA (1999b) concluded:

> "Over the five year period, this alternative will create 200,000 to 300,000 acres of DFPZ. CASPO Areas of Concern 1 and 3 located on the Lassen and Sierraville respectively, will incur activities that could, in the five year period, enlarge gaps and further increase owl habitat discontinuity over large landscapes. Resource management activities include group selection harvest, increasing the risk of management actions creating larger amounts of unsuitable habitat, edge effect, and reducing habitat connectivity."

As proposed under QLG, group selection cutting and DFPZs reduce canopy closure below levels suitable for the owl and remove medium to large trees (20-30" dbh) that are important components of quality owl habitat. Such habitat loss and degradation threatens the viability of the California spotted owl, necessitating its listing under the Endangered Species Act. The Record of Decision for the QLG essentially admits this, stating:

> "Alternative 2, as described in the DEIS and FEIS, would reduce the amount of owl nesting habitat by 7 percent over the term of the pilot project, and reduce the amount of foraging habitat by 8.5 percent, despite the protection provided by the interim direction guidelines. Such reductions in suitable habitat would decrease the number of California spotted owl home ranges with more than 50 percent suitable habitat by 11 percent over the term of the pilot project. In light of the recent demographic studies showing declining California spotted owl populations, such impacts to California spotted owl habitat could pose a serious risk to the viability of the California spotted owl in the planning area, thereby making implementation of Alternative 2 inconsistent with the National Forest Management Act and its implementing regulations."

To prevent risks to the viability of the California spotted owl, the 2001 Sierra Nevada Framework modified the QLG requiring the study to conform to all of the restrictions described above. The 2004, however, reversed this decision, allowing the QLG to go forward with standards weaker than those included in the Interim Guidelines, which were acknowledged to compromise the owl's viability. This will allow for the continued loss and destruction of the owl's habitat, necessitating its listing under the Endangered Species Act.

C. Logging on private lands

As noted above, logging on private lands has been more intensive for a longer period of time than on Federal lands. This has resulted in drastic declines in late-successional habitats utilized by the owl. For example, Beardsley et al. (1999) found that only two percent of the three million acres of private land could be classified as old-growth and Bias and Gutiérrez (1992) found that owls did not use private lands adjacent to Federal lands for nesting or roosting because they were deficient in several attributes of owl habitat. Despite the fact that Verner et al. (1992) estimated there are 2.4 million acres of potentially suitable owl habitat on private lands in the Sierra Nevada, to date only 314 owl territories have been documented on private lands (US fish and Wildlife Service 2003, p. 7484). Of these owl sites, only about 30% have been visited since 1995, leaving the status of the remaining 70% uncertain. Because of substantial loss of habitat, it is unlikely that there are large numbers of undiscovered spotted owl territories on private lands (Beardsley et al. 1999). If there are reserves, there is cause for serious concern because intensive logging is ongoing on private lands and there are almost no protections for spotted owls on these lands (see below). As is demonstrated in the analyses below, owls are being heavily impacted by logging on private lands.

1. Logging on private within 2 miles of selected owl sites from 1990 to 1999

We assessed the amount and type of logging occurring within two miles of known California spotted owl (CSO) sites. A database of California spotted owl locations maintained by the California Department of Fish and Game (Gould unpublished data) was used to identify sections of private land within two miles of known owl sites. The sections were forwarded to the California Department of Forestry (CDF) from whom we requested harvest planning documents submitted 1990-1999 that occurred within these sections. This request revealed that more than 12,000 Timber Harvest Plans (THPs) or exempted timber harvests had occurred near owl sites during the 10 year period.

Because the CDF database lacks a spatial component, however, it was impossible to determine from the available data how many acres of various logging prescriptions occurred within the specific sections we had identified and the large number of THPs made detailed review impossible. Thus we were not able to quantify effects to all owls on or adjacent to private lands in detail. In and of itself, however, the sheer amount of logging that has occurred 1990-1999 near spotted owl territories in the Sierra Nevada is instructive to the degree of habitat destruction that is occurring on these lands.

To provide more specific information about the level of impacts occurring in and around home ranges of owls located on private lands in the Sierra Nevada, we conducted a detailed analysis of selected owl sites. The purpose of the case studies was to evaluate a representative sample of owl sites as to the level of impacts occurring within 0.5 and 2 miles of owl sites as a result of logging within owl habitat.

This analysis revealed extensive impacts to land within 0.5 and 2 miles of owl sites we reviewed, and almost no mention, analysis, or mitigation of these impacts in the associated timber harvest documents.

a. Analysis Methods

While scattered private lands exist throughout the Sierra Nevada, the CASPO report identified several areas in the Sierra Nevada where concentrations of private lands are located and identified them as "Areas of Concern." (Beck and Gould 1992). We focused our analysis on owls in four of the Areas of Concern (AOC) in which a concern about private lands had been identified in the CASPO report.

Within each of the four AOCs that present concerns due to presence of private lands, we selected five owl locations for further

examination. These sites were selected at random, from the set of owl locations on private land that were found within the AOC boundaries. We then prepared a list of all sections of land that were within or were intercepted by a two mile radius circle, the center point of which was the known owl site. The area encompassed by this radius is about 8,000 acres, which is within the size range of documented owl home ranges.

We submitted this list to the CDF, again requesting copies of all THPs that occurred within these sections. These timber harvest plans and all associated maps were then analyzed to determine as accurately as possible the precise nature of impacts within 2 miles of the identified owl sites, and within 0.5 mile of owl sites. The following discussion summarizes the results of this analysis.

b. Results

Most of the timber sales were conducted under exemptions to the THP process (287 out of 416, or 69%). The exemption process is limited to a one-two page application and as a result little information was provided on the intensity and type of cutting to occur under these harvest documents. Even in those cases where more detailed analysis was performed in a THP, such analysis in the vast majority of cases did not focus on effects on the owl or components of its habitat (see below). Thus while impacts from timber harvest have affected numerous acres of potential owl habitat during the review period, the analysis we were able to complete has limitations that are inherent to the data available.

Beck and Gould (1992) identified four Areas of Concern in the Sierra Nevada due to the presence of a large private land component. We assessed impacts to owl sites by the area of concern within which they occur and use the map and numbering system established by Beck and Gould (1992).

Our analysis revealed extensive impacts to land within one-half and two miles of the owl sites we reviewed for the period 1990 to 1999. A total of 416 documents indicated that harvest units occurred within two miles of the 18 owl sites with 116 documents containing units that occurred partially within one-half mile of an owl site. In total, these 416 timber sales proposed harvest on more than 2.3 million acres both in and out of the two mile radius around known owl sites. This number includes all acres

Table 12. Summary of acres affected by the reviewed planning documents.

Area of Concern	Owl sites affected	Number of planning documents	Acres of THPs with units partially w/in 2 miles of owl site	Acres of Exemptions with units partially w/in 2 miles of owl site	Acres of Emergencies with units partially w/in 2 miles of owl site	Total acres of planning documents with units partially w/in 2 miles of owl site	Number of THPs with units w/in 0.5 miles of owl site	Number of Exemptions with units w/in 0.5 miles of owl site	Number of Emergencies with units w/in 0.5 miles of owl site	Documented acres w/in 2 miles of owl site
2	5	58	24,145	870,115	4,925	899,185	2	17	3	85,414
3	3	18	3,143	20,066	20	23,229	0	2	0	13,411
4	5	136	16,582	594,977	0	611,559	14	23	0	80,863
5	5	204	37,947	881,595	18,752	938,294	16	31	8	119,733
Total	**18**	**416**	**81,817**	**2,366,753**	**23,697**	**2,472,267**	**32**	**73**	**11**	**299,421**

Table 13. Harvest documents proposing activity within 2 miles of 18 selected owl sites.

Year	Number of THPs	THP acreage	Number of Exemptions	Exemption Acreage	Number of Emergencies	Emergency Acreage
1990	15	11,215	17	152,656	17	11,662
1991	19	15,978	16	94,912	5	4,520
1992	14	8,778	26	227,948	0	0
1993	11	4,797	34	263,731	2	1,800
1994	12	5,059	49	299,187	0	0
1995	10	5,357	28	359,962	5	4,925
1996	24	13,263	34	384,097	1	20
1997	8	4,998	29	354,018	1	60
1998	16	12,373	15	229,946	2	710
1999	no data	no data	6	129,814	0	0
TOTAL	**129**	**81818**	**254**	**2496271**	**33**	**23697**

associated with timber harvest operations and fewer acres were actually located within the 2 mile radius circle around owl sites. There was sufficient detail in 310 documents to evaluate if harvest areas were within 2 miles of an owl site. For these cases, a total of 302,339 acres occurred within 2 miles of an owl site.

The majority of the documents were exemptions (254 cases covering 2,366,753 acres) followed by THPs (129 cases covering 81,817 acres) and then emergencies (33 cases covering 23,697 acres) (Table 12). The number of planning documents per AOC varied substantially with a low of 18 for AOC 3 to a high of 204 for AOC 5. AOC 5 also contained the greatest number of documented harvest acres within 2 miles of a nest stand (119,733 acres).

The number of THPs and exemptions filed and their respective acreage varied somewhat by year for the period 1990 to 1999 (Table 13). The patterns suggest that harvest operations are not declining over this period and appear to be somewhat stable.

In many cases, THPs were proposed in the same area as exemptions for the period between 1990 and 1999. An estimate of the total number of THPs that occurred within areas that had come under exemptions for the period of review is difficult to determine, nevertheless the following examples illustrate the pattern. In AOC 2, exemptions were filed 5 times on the same 92,634 acre area between 1990 and 1999. During this same period and in this same area, 5 THPs totaling 20,158 acres were filed. In AOC 4, exemptions were filed 7 times on the same 68,382 acre area between 1990 and 1999. During this same period and in this same area, 17 THPs totaling 9,698 acres were filed. In total, numerous exemptions were filed repeatedly on the same 324,840 acres during the period 1990 and 1999. During this same period and in the same area, 81 THPs totaling 70,365 acres were filed. The harvest activities associated with these timber harvests removed habitat elements (i.e. large trees, large snags, multi-layered canopies) required to maintain California spotted owl habitat. Despite the magnitude of effects to California spotted owls, the impacts of these harvest activities are not disclosed or mitigated in the harvest documents.

i. Area of Concern 2

Area of Concern 2 is located in northern Plumas County, within boundary of the Lassen National Forest and adjacent to the Plumas National Forest boundary. Beck and Gould (1992) describe this area of concern as "A gap in known distribution [of the spotted owl], mainly on private lands, extends east-west in a band almost fully across the width of the owl's range."

Within this area of concern, owl sites bearing

the following Gould database identification numbers were examined: PL001; PL053; PL306; PL 164; and TE096. These owl sites were affected by 57 timber harvest operations on private lands between 1990 and 1998, impacting a total of 899,185 acres, both within and near likely owl home ranges (Appendix A). The 30 of these timber harvest operations that were accompanied by detailed information as to location of impacts affected 85,414 acres within 2 miles of the five owl sites.

The primary harvest method was harvesting of dead, dying, or diseased trees under a THP exemption, which is not defined in the Forest Practice Rules, but appears to be most similar to the sanitation or salvage logging methods (FPR section 953.3(b)). Given that there are no provisions under the Rules to protect large trees, snags, high canopy closure or other components of owl habitat when conducting this type of harvest, it is certain that owl habitat was lost on many of the acres slated for harvest in the reviewed documents.

Of the 57 timber harvest operations within 2 miles of the five owl sites analyzed, 22 involved impacts that occurred within .5 miles of an owl site (Appendix A). Despite the proximity of logging operations to spotted owl sites, only 7 mention the California spotted owl in any manner. Of these 7 references to the owl, only 1 actually identifies the Gould database owl location; only 3 identify presence of occupied owl habitat, and none identify any anticipated impacts to the nearby owl or its habitat. None identifies the cumulative effects of the numerous timber sales occurring in and around each owl area. Further, of the 57 timber harvest documents, none identifies the presence of late successional forest or impacts to late successional forest. Given this failure to even identify spotted owl locations or habitat, it is clear that no specific actions were taken to protect or limit impacts to owl habitat. Instead, extensive logging appears to have occurred in close proximity to owl sites, in areas that have been identified by Beck and Gould (1992) as important to the owl's long term viability.

ii. Area of Concern 3

Area of Concern 3 is located in the Tahoe National Forest, and is described by Beck and Gould (1992) as "an area of checkerboard lands; much dominated by granite outcrops and red fir forests; both features guarantee low owl densities."

Within this area of concern, owl sites bearing the following identification numbers were examined: PC045, SI042, SI043, NV005, and NV 010. No data were available from the CDF for owl sites NV005 and NV010. Thus, the following summary represents only timber harvest operations associated with owl sites PC045, SI042 and SI043.

These three owl sites were affected by 18 timber harvest operations on private lands between 1990 and 1998 (Appendix A). These timber harvest operations impacted a total of 23,229 acres, both within and near likely owl home ranges. Of these, we were able to determine that 13,411 acres were actually within 2 miles of the three owl sites, indicating a substantial amount of the acreage within two miles of these sites was impacted.

Similar to AOC 2, the primary harvest method was harvesting of dead, dying, or diseased trees, which is not defined in the Forest Practice Rules, but appears to be most similar to the sanitation or salvage logging methods (FPR section 953.3(b)). The rules fail to provide restrictions under this type of harvest for retention of large trees or snags, high canopy closure or other components of owl habitat.

Of the 18 timber harvest operations within two miles of the five owl sites analyzed, two involved impacts that occurred within .5 miles of an owl site. Despite the proximity of logging operations to spotted owl sites, none of the timber harvest documents identify owls within the planning area, although seven do mention California spotted owl sites on nearby or adjacent national forest land. None identifies

the cumulative effects of the numerous timber sales occurring in and around each owl area. Further, of the 18 timber harvest documents, only one identifies late successional forest acres, and none identifies impacts to late successional forest. In one case, a timber harvest document identifies the affected stand as a "virgin stand," but does not identify a single acre of late successional forest. Given this failure to even identify spotted owl locations or habitat, it is clear that no specific actions were taken to protect or limit impacts to owl habitat and indeed none of the documents identified any action would be taken to minimize or remove effects on spotted owls or their habitat. Instead, extensive logging appears to have occurred in likely owl home range habitat, in an AOC that has been identified by the CASPO report as important to the owl's long term viability.

iii. Area of Concern 4.

Area of Concern 4 is located in the northern part of the Eldorado National Forest. Beck and Gould (1992) describe this AOC as characterized by "[c]heckerboard lands and large, private inholdings; owl densities unknown on some private lands and very low on others."

Within this area of concern, owl sites bearing the following Gould database identification numbers were examined: ED014, ED045, ED198, PC037, and PC051.

There were 136 logging operations partially located within 2 miles of the five owl sites assessed in AOC 4 (Appendix A). The total number of acres affected by the harvest documents both within and outside the two mile area totaled 611,559 acres. Detailed information as to the location of impacts was only available for 85 of the plans, and these plans affected approximately 80,863 acres within two miles of owl sites, indicating that potentially a majority of the acres were effected and that definitely some acres were entered more than once.

Of the 136 timber harvest operations within two miles of the five owl sites analyzed, 53 involved impacts that occurred within one-half miles of an owl site. Despite the proximity of logging operations to spotted owl sites, only 27 of the timber harvest documents mention owls, mostly noting owls on adjacent national forest land. Only one of the documents identified an owl site within the planning area. None identifies the cumulative effects of the numerous timber sales occurring in and around each owl area. Further, of the 136 timber harvest documents, only two identify late successional forest acres, one identifies impacts to late successional forest, and none identifies mitigation measures to reduce impacts. Given this failure to even identify spotted owl locations or habitat, it is clear that few specific actions were taken to protect or limit impacts to owl habitat, nor were specific actions mentioned in any of the documents. As with the other AOCs, extensive logging occurred in owl home ranges, in an AOC that has been identified as important to the owl's long term viability.

iv. Area of Concern 5

Area of Concern 5 is located in the northwest portion of the Stanislaus National Forest, and is described by Beck and Gould (1992) as having "large private inholdings; owl densities unknown on most private lands."

Within this area of concern, owl sites bearing the following identification numbers were examined: CA011, CA032, TL037, TL 152, and TL201.

There were 204 logging operations partially located within two miles of the five owl sites assessed in AOC 5 (Appendix A). The area affected by the THPs both within and outside the two mile area totaled 938,294 acres. Detailed information as to the location of impacts was only available for 124 of the harvest documents, and these plans affected approximately 119,733 acres within two miles of owl sites.

Of the 204 timber harvest operations within two miles of the five owl sites analyzed, 69 involved impacts that occurred within .5 miles of an owl site (Appendix A). Despite the proximity of logging operations to spotted owl sites, only 42 of the timber harvest documents mention owls, mostly noting owls on adjacent national forest land. Only 6 of the documents identified owl sites within the planning area, and only one document described a mitigation intended to reduce impacts to the located owl. None identifies the cumulative effects of the numerous timber sales occurring in and around each owl area. Further, of the 204 timber harvest documents, only six identify late successional forest acres, and none identifies impacts to late successional forest. Similarly, all except one document failed to propose or carry out any actions to protect or limit impacts to owls or their habitat, despite the fact that the documents propose extensive logging near known owl sites within an AOC.

2. Assessment of Timber Harvest Plans Within the Summer Range of California Spotted Owl in the Sierra Nevada January 1999 to July 2002

This analysis examines the intensity and extent of timber harvest proposed on private lands within the range of spotted owl in the Sierra Nevada. The complete report is attached to this petition (Britting 2002) and the results are summarized below.

a. Analysis methods

As described in detail in the attached report, data from the California Department of Forestry and Fire Protection (CDFF) was used to complete an analysis of timber harvest proposed throughout the Sierra Nevada for the period January 1999 to July 2002. The non-spatial data provided by the CDFF was associated with a map based on township, range and section coordinates.

b. Results

A total of 765 THPs occurred with the summer range of the CSO for the period 1999 to 2001. (Table 14). Silvicultural treatments for these treatments covered 216,675 acres.

For the period 1999 to 2001, 29 different silvicultural prescriptions were identified. For the purposes of this analysis, silvicultural prescriptions where grouped into three categories: even-aged, uneven-aged, or other. The grouping of prescriptions is displayed in Table 15.

Table 14. Summary of THPs submitted to the CDFFP within the summer range of CSO in the Sierra Nevada by year.

Year	# of THPS	Total Area (ac)	Silvicultural Area (ac)
1999	286	95,156[a]	94,719
2000	244	60,245[b]	58,318
2001	182	55,395[c]	55,212
2002 (as of July 25, 2002)	53	8,404	8,426
Total	**765**	**291,200**	**216,675**

Notes:
a – Four THPs were reported without total acreage estimates
b – Two THPs were reported without acreage estimates
c – Three THPs were reported without acreage estimates

Table 15. Classification of prescriptions presented in Table 3. Full prescriptions taken from the CDFFP statewide data base for the period 1999 to 2002.

Even-aged	Uneven-aged	Other
Alternative (Sd Tr Rem/CT)	NTMP Uneven-aged	No-harvest(Non-Timberland)
Clearcutting	Group Selection	No-harvest (H2O Course Prot.)
Shelterwood Prep	Selection	No-harvest (Wild/Plant Prot.)
Shelterwood Removal	Transition	No-harvest (Hillslope Stabl.)
Shelterwood Seed	Alternative (Group Selection)	Rehabilitation
Seed Tree Removal	Alternative (Selection)	Sanitation Salvage
Seed Tree Seed	Alternative (Transition)	Special Treatment
Alternative (Clearcutting)		Alternative (Rehabilitation
Alternative (Shw'd Rem/CT)		Alternative (Special Treatm.)
Alternative (Shw'd Rem/San)		Fuelbreak
Alternative (Seed Tree Rem)		Right-Of-Way (Road Const.)
Alternative (Seed Tree Seed)		Conversion
Alternative (Shelterwood Pr)		Alternative (other)
Alternative (Shelterwood Re)		Substantially Damaged Tmbrl.
Alternative (Shelterwood Se)		Commercial Thinning

Table 16. Acreage of each prescription group included in THPs within the summer range of CSO in the Sierra Nevada between 1999 and 2002. Prescription groupings are as outlined in Table 15.

Year	Even-aged (ac)	Uneven-aged (ac)	Other (ac)	Total (ac)
1999	35,171	41,334	18,214	94,719
2000	27,894	20,366	10,058	58,318
2001	24,254	18,572	12,386	55,212
2002 (as of July 25, 2002)	2,191	3,676	2,559	8,426
Total	**89,510**	**83,948**	**43,217**	**216,675**

Of the acreage submitted for THPs within the summer range of CSO for the period 1999 to midway through 2002, 41.3 % was identified as even-aged management and 38.7% was identified as uneven-aged management. The remaining 20% was identified as other prescriptions. (Table 16).

A total of 487 different land owners submitted THPs. (Table 17). Of these, approximately 76% of the acres to be harvested were owned by 13 parties. The 5 parties submitting the greatest number of acres to be treated accounted for over 54% percent of the acres to be treated in this period.

Sierra Pacific Industries (SPI), the major private land owner in the Sierra Nevada, submitted THPs covering 68,960 acres for the period 1999

to mid-2002. (Table 18). This amounts to about 31 percent of all the acres identified in the THPs submitted in the Sierra Nevada.

Sorted by county, THPs for period 1999 to mid-2002 affected between 6 percent and 13 percent of the private coniferous forest land per county. (Table 19).

Table 17. Distribution of acreage treated by owner.

Area Treated by Owner (acres)	Number of Owners	Total Area Treated	Proportion of All Area Treated
Up to 100	343	11,519	5.3%
101 to 1,000	126	32,960	15.2%
1,001 to 5,000	5	7,528	3.5%
Over 5,001	13	164,668	76.0%
Total	**487**	**216,675**	

Table 18. Comparison of Sierra Pacific Industries THP submission to all THPs submitted within the summer range of CSO in the Sierra Nevada.

Year	Even-aged (ac)	Uneven-aged (ac)	Other (ac)	Total (ac)
SPI	41,630	9,790	17,544	68,960
All others	47,880	74,158	25,673	147,715
Total	**89,510**	**83,948**	**43,217**	**216,675**

Table 19. Distribution of acreage in THPs by county. County data from PRIME California Inventory Data 1997.

County	Forest Industry	Other	Total Private	Total Rx acres 1999 to 2002	% treated in 42 months
Amador	27,000	34,000	61,000	6,487	11
Butte	153,000	76,000	229,000	18,548	8
Calaveras	53,000	83,000	136,000	8,318	6
El Dorado	120,000	131,000	251,000	16,956	7
Fresno and Madera	0	60,000	60,000	7,817	13
Lassen	281,000	63,000	344,000	26,612	8
Mariposa	0	31,000	31,000	1,946	6
Nevada	36,000	163,000	199,000	17,225	9
Placer	69,000	93,000	162,000	10,228	6
Plumas	216,000	100,000	316,000	25,438	8
Shasta	527,000	175,000	702,000	34,975	5
Sierra	63,000	48,000	111,000	12,687	11
Tehama	196,000	9,000	205,000	18,369	9
Tulare and Kings	0	23,000	23,000	1,378	6
Tuolumne	66,000	51,000	117,000	6,714	6
Yuba	34,000	42,000	76,000	5,782	8
TOTAL	**1,841,000**	**1,182,000**	**3,023,000**	**219,480**	**7**

Table 20. Retention levels in the range of CSO required under the CFPR (CFPR 913.2, 933.2, 953.2, 913.3, 923.3, 953.3).

Silvicultural Method	Retention Required
Selection	75 to 125 sq. ft. basal area per acre depending on site class
Group selection	Groups from 0.2 to 2.5 acres and not covering more than 20% of the stand; 80% of stacked plots must meet 75 to 125 sq. ft. basal area per acre depending on site class
Commercial Thinning	50 to 125 sq. ft. basal area per acre depending on site class and forest type; or where dominant canopy in trees 14" DBH or less 75 to 100 trees per acre depending on site class
Shelterwood Seed Step	Retain at least 16 trees 18" DBH or greater and trees over 24" DBH count as two trees; 50 to 125 sq. ft. basal area per acre depending on site class
Seed Tree Step	Retain at least 8 trees 18" DBH or greater and trees over 24" DBH count as two trees

c. Discussion

i. Retained forest structure

The California Forest Practice Rules (CFPR) are part of the regulatory framework that govern the harvest of private forests. Among other things, the CFPR direct the retention of trees of specific size and quantity for various silvicultural prescriptions. Specifically, the rules direct the retention of trees in intermediate, uneven-aged, and some stages of even-aged prescriptions. (Table20).

In all cases, these basal area retention levels are considerably less than the levels identified as used by CSO for nesting, roosting and foraging throughout the Sierra Nevada (Verner et al. 1992, p. 84-91).

Clearcutting has the largest and possibly longest term effect on CSO habitat. Rarely in clearcut harvest units are snags, down logs or oaks left in the unit (see for example Britting 2002, Figure 6). In the Sierra Nevada region, clearcutting is often applied in repetitive, uniform blocks across the landscape. Uniform blocks are dispersed across the landscape with adjacent blocks differing in age by 10 or so years. (Ibid.). This creates a patchwork of uniform blocks over the landscape and within 30 years most of the private ownership in a watershed can be composed of stands less than 30 years old. Not only are the stands uniform in age, but tree species diversity is low (dominated by ponderosa pine) and understory vegetation is extremely limited due to the application of herbicides. The absence of snags and downed logs further simplifies this landscape and limits its habitat value.

ii. Modifying stand structure of the future.

As demonstrated above, an immediate effect of commonly used silvicultural prescriptions supported in the CFPR can be to render existing owl habitat unsuitable. Long term effects of such management are apparent as well. Beardsley et al. (1999, Table 5) reported for the Sierra Nevada bioregion that about 12.3 percent of the private coniferous forest lands had mean stand diameters that exceeded 21inches. Thus, private land in the Sierra Nevada is dominated by young stands with mean diameters less than 21" DBH. This finding by Beardsley et al. (1999) is supported by the inventory completed by Sierra Pacific Industries, which owns about 80 percent of the private coniferous land in the Sierra Nevada, which reports an average of 18 inches in diameter for trees on their lands (US Fish and Wildlife Service 2003, p. 7606). In such stands, large trees numbers are quite low and far different from the stand conditions known to support owls in the Sierra Nevada (Blakesley 2002, personal communication; North et al. 2000; Verner et al. 1992). For

Table 21. Old growth definitions for large trees from Beardsley et al. (1999, Table 13).

Forest Type	Size and Number of Large Live Trees per Acre
Interior ponderosa	Trees 21" or greater – 30 per acre Trees 30" or greater – 3 per acre
Mixed conifer	High site class: trees 39" or greater – 8 per acre Medium site class: trees 39" or greater – 6 per acre Low site class: trees 29" or greater – 5 per acre
Red fir	High site class: trees 30" or greater – 12 per acre Low site class: trees 30" or greater – 7 per acre

instance, inventories on Sierra Pacific Industries holdings covering about 1.1 million acres indicate that basal area per acre of trees greater than 30 inches in diameter ranges from 0.07 to 1.65 square feet per acre depending on tree species (Sierra Pacific Industries 1999, p. 8). On average there is less than one tree greater than 30 inches in diameter on land held by Sierra Pacific Industries (Ibid.)

Rotation age is also an important consideration in evaluating the effect of timber harvest on habitat. A rotation age of 80 years is not uncommon in the Sierra Nevada with rotations as short as 60 years occurring, especially under clearcut and other even-aged prescriptions. (See for example Sierra Pacific Industries 1999, p. 16). This means that over time the intention is to have no trees in the treated landscape that are greater than 60-80 years in age. North et al. (2000, Table 3) found that mean nest tree age in mixed conifers was greater than 229 years for CSO within the demographic study on the Sierra National Forest and Sequoia-Kings Canyon National Park. Similarly, Blakesley (2003) found that in the Lassen demographic study area, trees greater than 36" DBH were used 75 percent of the time. In this same study, 29 nest trees 30" DBH and greater were cored and tree age estimated. Three hundred-ten years was the average estimated age for the sample. Given these estimates, it is unlikely that the large trees utilized as nest trees will be available in even-aged forests with rotations of 80 years or less.

The absence of large trees on private lands in the Sierra Nevada is again affirmed by the work of Beardsley et al. (1999). They report that less than 2 percent of private coniferous forests had sufficient numbers of large trees, snags and downed logs per acre to meet the definition of old growth The number of large trees per acre required to meet the old growth definitions for the primary forest types utilized by CSO are listed in Table 21. Furthermore, 79 percent of the Sierra Nevada has less than 1 tree per acre greater than 40" DBH.

Large live snags are important habitat components for CSO nesting and roosting. (Blakesley, in prep.; North et al. 2000, Verner et al. 1992). Large dead snags and down logs are important elements in support of the prey base for CSO. (Verner et al. 1992). The CFPR allow snags to be left if they have no commercial value and are not a safety hazard. Because they CFPR does not direct the retention of snags regardless of commercial value, few to no snags are left during harvest operations and the recruitment of large down wood is not provided for. (See for example Britting 2002, Figure 5).

Habitat favored by CSO includes stands with a strong representation of large trees, including large snags and down logs. (Blakesley 2003; Verner et al 1992, pp. 84-91). Since large diameter trees are missing from the private coniferous forests and current practices do not provide for large trees to persist into the future, habitat for CSO is likely not adequately provided for on private lands in the long term. As concluded in by Verner at al. (1992, p. 16) "… existing state regulations do not assure maintenance of owl sites on private lands."

3. Regional analysis of the Southern Forest District 1990 to 2003

This analysis examines the intensity and extent of timber harvest plans proposed in the Southern Forest District which includes significant portions of the Sierra Nevada and the summer range of the California spotted owl.

a. Analysis methods

This regional analysis uses the geographic information system (GIS) database of timber harvest plans (THPs) created by the California Department of Forestry and Fire Protection for the Southern Forest District. (California Department of Forestry and Fire Protection 2003 and 2004). The timber harvest data for the Southern Forest District includes projects in El Dorado County in the north to San Bernardino County in the south and covers 11 counties. A smaller assessment area consisting of 22 planning watersheds in the Stumpy Meadows area (El Dorado County) was also examined. This area was selected because it contains a high proportion of private land and has been actively managed during the period of interest. ArcView 3.2, a geographic information software, was used to evaluate the type of timber harvest and land owner proposing the timber harvest for the period 1992 to 2003 for each analysis area.

b. Results

Private timber land in the 11 counties represented in the database covers approximately 3.0 million acres (PRIME Timber Inventory 1999). Approximately 367,082 acres or 12% of this area has been harvested since 1992 (Tables 19 and 22).

A number of management approaches are used in this landscape. Using the prescription classes defined in Table 20, above, the table below displays the distribution of acres to be harvested. (Table 22). The acreage of uneven-aged management peaked in 1996 and has dropped since that time. (Figure 3). Since 1999 there has been an increase in even-aged management in this area. This management class now generally exceeds all other types.

Table 22. Acreage identified in THPs from 1990 to 2003 in the Southern Forest District.

Year	Alternative	Even-aged	Other	Uneven	TOTAL
1992	7,882	1,305	5,340	15,655	30,181
1993	4,772	2,828	12,368	22,397	42,365
1994	4,632	3,995	5,978	26,402	41,007
1995	6,607	4,079	5,330	22,159	38,175
1996	6,389	16,544	17,300	27,165	67,397
1997	1,987	5,757	7,675	16,137	31,556
1998	1,089	7,265	5,252	11,150	24,757
1999	1,143	10,327	3,156	8,405	23,030
2000	1,913	4,221	1,889	3,801	11,824
2001	5,008	3,823	3,100	5,650	17,581
2002	4,276	8,535	3,086	5,164	21,061
2003	3,807	7,263	3,494	3,583	18,148
TOTAL	**49505**	**75941**	**73968**	**167667**	**367,082**

Figure 3. Trend of management types from 1992 to 2003 in the Southern Forest District. Data values from Table 22,

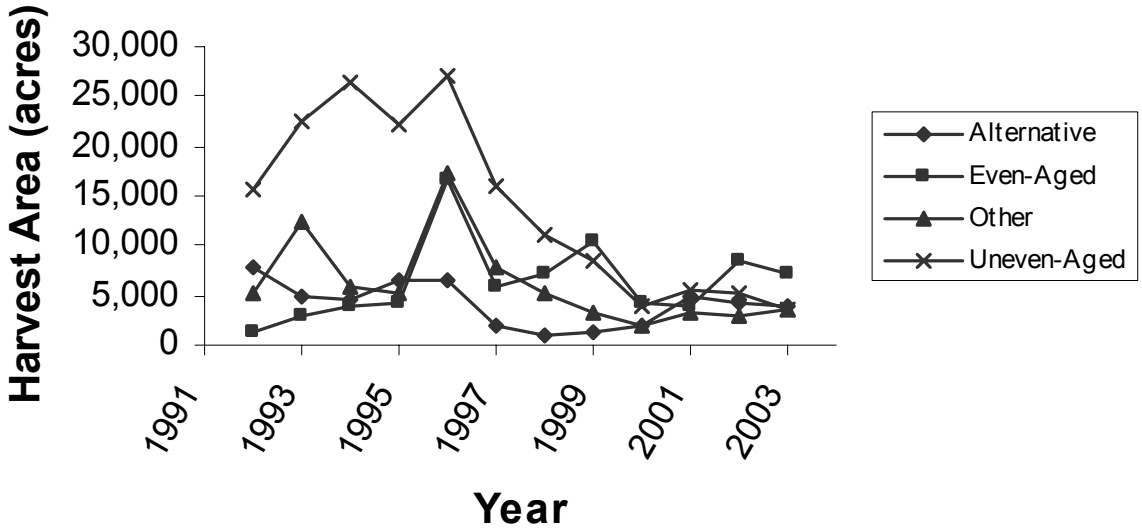
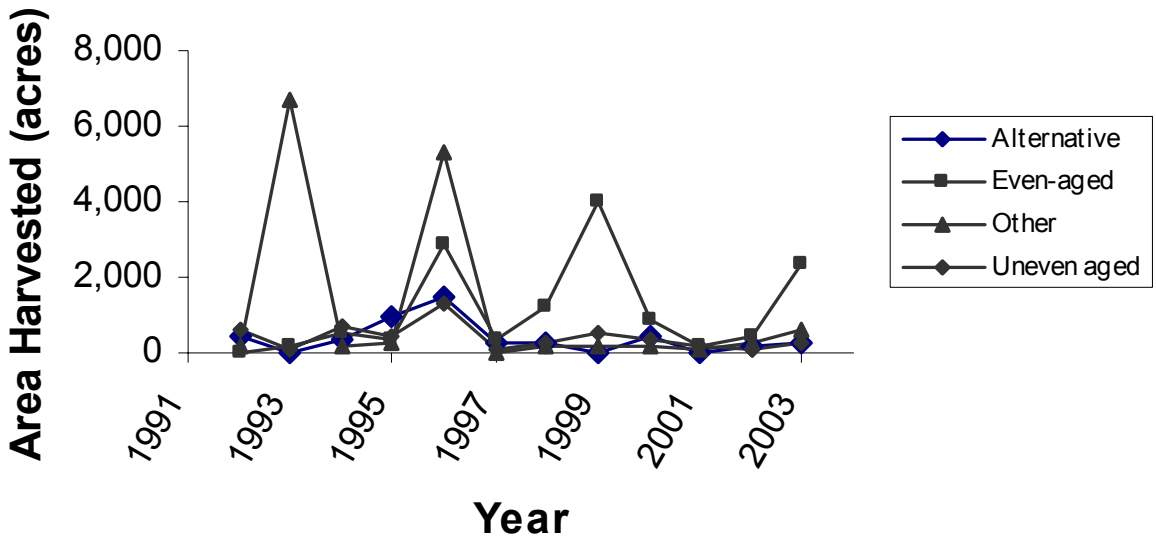


Table 23. Distribution of area proposed for harvest by land owner.

Land owner	Harvested Area (Acres)	Proportion of Total (%)
Sierra Pacific Industries	130,365	36
Georgia Pacific	58,650	16
Westsel-Oviatt Lumber Company	21,744	6
Southern California Edison	21,720	6
Fiberboard Corporation	11,342	3
Other owners	123,261	34
TOTAL	**367,082**	**100**

Figure 4. Trend of management types in the Stumpy Meadows regional assessment for the period 1992 to 2003.



Throughout this forest district and during this time period over 1,000 different land owners submitted THPS. Most of these THPs were small and less than 1,000 acres in size. Overall, five industrial land owners dominated the submissions of THPs and accounted for about 66% of the area proposed for harvest. (Table 23).

In order to compare how "average" management throughout the Southern Forest District, as portrayed in Table 22, compares with localized areas within the district, we examined the timber harvest plan activity in an area covering 22 planning watersheds around Stumpy Meadows Reservoir (El Dorado County) for the same time period. As can be seen from the Figure 4, the general patterns are similar to those reflected throughout the district with even-aged management becoming the dominant practice in recent years.

As with the assessment for the entire forest district, the majority of the harvested areas are owned by industrial land owners. (Table 24). However, in the regional analysis area nearly half of the acres harvested are held by one owner. Thus, the management practices of a single ownership dominate this landscape to a greater degree than elsewhere in the forest district.

Table 24. Ownership of area harvested in the Stumpy Meadows regional analysis area for the period 1992 to 2003.

Owner	Area (acres)	Proportion of Watershed Area (%)
Sierra Pacific Industries	17,545	48
Georgia Pacific	6,603	18
Other	12,675	34
TOTAL	**36,823**	**100**

Table 25. Trend of management types from 1992 to 2003 on Sierra Pacific Industries land in the Stumpy Meadows regional assessment area. See Britting (2004) for exact location of assessment area.

Prescription Class	Area (acres)	Proportion of Total Harvested (%)
Even-aged	9,442	54
Uneven	1,315	7
Alternative	1,029	6
Other	5,759	33
TOTAL	**17,545**	**100**

A closer evaluation of the management practiced by Sierra Pacific Industries, the dominant private owner in the regional assessment and forest district assessment, indicates that nearly half of their lands harvested during the period 1992 to 2003 used even-aged management (Table 25). This means that about 25% of the area in the regional assessment area was harvested using an even-aged management method. As can be seen from Table 25, even-aged management includes clearcutting, seed tree and shelterwood harvest methods. Examination of the specific practices used by SPI on the 9,442 acres listed in Table 25 indicate that 9,035 acres or 96% of the area harvested with even-aged management utilized clearcutting as the specific method. Thus, about 24% of the lands in the regional assessment area were harvested using a clearcut prescription. This compares to about 12% of the lands in the Southern Forest District to which clearcutting was applied and suggests that the regional assessment area is being affected to a greater degree than elsewhere by clearcutting.

c. Discussion

From 1992 to 2003, the CDF accepted THPs covering 367,082 acres in the Southern Forest District. There are approximately 3.0 million acres of private forest lands within the eleven counties for which THPs were submitted. (Table 19). Thus, about 12 percent of the private coniferous forests on private lands were harvested during this period.

Comparing these estimates of harvest with the regional values for the period 1992 to 2003 indicates that specific regions in the Sierra Nevada are being harvested at a much greater rate than indicated by forest district values. There are approximately 95,016 acres of private land in the regional analysis area. The THPs submitted for the period 1992 to 2003 covered 36,082 acres or about 39% of the private land in the regional analysis area. Thus, some regions of the Sierra Nevada may be experiencing harvest rates that are several times greater than the mean rate for the Sierra Nevada. California spotted owl in these areas will be disproportionately affected by the existing THP regulations which do not adequately protect the species.

In the regional analysis for the period 1992 to 2003, even-aged management covered 14 percent of the private land in the analysis area. Since 1996, the use of even-aged management has been increasing. Similarly, even-aged prescriptions Sierra Nevada-wide during the period 1999 to mid-2002 covered the greatest number of acres (Table 3). Sierra Pacific Industries (SPI), the major private forest landowner in the Sierra Nevada, accounted for about 31 percent of the acreage submitted under THPs in the Sierra Nevada between 1999 and mid-2002. (Table 18). Furthermore, prescriptions utilized by SPI are dominated by even-aged management (Table 25) and in particular clearcutting. Considering the pace and scale of timber harvest recently completed by SPI and proposed in their long-term planning documents (Sierra Pacific Industries 1999), it

can be reasonably predicted that even-aged harvest, with a particular emphasis on clearcutting, will be applied to the majority of the actively managed timberlands in the Sierra Nevada. Thus, in the near future, privately owned coniferous forests are likely to be dominated by stands less than 30 years old, with few large and very large live trees, little structure heterogeneity, and few large snags and logs. These areas will provide marginal to unsuitable habitat for CSO.

4. Localized Effects of Logging in the Central Sierra Nevada

This analysis examines an area affected by recent timber harvests on private land in the central Sierra Nevada. The area harvested or to be harvested using the clear cutting prescription is quantified for twenty-seven sub-basins selected from this region.

For one sub-basin, the recorded sightings of California spotted owl are compared to the timber harvest history for that area.

a. Analysis methods

This regional analysis uses the geographic information system (GIS) database of timber harvest plans (THPs) created by the California Department of Forestry and Fire Protection for the Southern Forest District. (California Department of Forestry and Fire Protection 2003). This analysis also relies upon interpretation of digital ortho photo quad (DOQQ, US Geological Survey) and the California spotted owl sighting database created by Sierra Pacific Indiustries. The details of the analysis methods are presented in Britting (2003).

b. Results and discussion

The extent of THPs that have been submitted to the Department of Forestry and Fire Protection for the period 1990-2002 in the region around Calaveras Big Trees State Park is shown in Britting (2003, Map 1). In combination, the orange and red areas on the map represent those lands included in THPs for this period. In many cases (see for example watersheds 1, 2, 14, 15), nearly all of the private land within the sub-basin has been included in a THP during the past 12 years. Harvest prescriptions outside of clear cut areas include other even-aged (e.g. shelterwood), uneven-aged (e.g. selection), intermediate (e.g. commercial thinning), and special (e.g. fuelbreak) prescriptions.

Britting (2003, Table 1) summarizes the area approved to be clear cut in selected basins that occur within Map 1 (Britting 2003). The portion of a sub-basin approved for clear cutting ranges from 2% to 21%. When the clear cut areas are considered with respect to private lands alone in the each sub-basin, the portion of a sub-basin approved for clear cutting ranges from 2% to 26% for the twelve year period. Sub-basin 18 has had 26% approved for clear cutting in the past 12 years. The continuation of this rate of harvest would result in clear cutting all of the private lands in this sub-basin within 50 years and result in a stand rotation age of about 50 years.

Britting (2003, Map 2) shows the extent of THPs that have been submitted to the Department of Forestry and Fire Protection for the period 1990-2002 in the region around Blodgett Experimental Forest and south of the El Dorado Demographic Study area. Similar to Britting (2003, Map 1), the orange and red areas on the map represent lands included in THPs for this period.

Britting (2003, Table 2) summarizes the area approved to be clear cut in selected basins that occur within Britting (2003, Map 2). The portion of a sub-basin approved for clear cutting ranges from 2% to 11%. When the clear cut areas are considered with respect to private lands alone in the each sub-basin, the portion of a sub-basin approved for clear cutting ranges from 2% to 14% for the twelve year period.

As can be seen in Britting (2003, Map 3), more area has been clear cut near Blodgett

Experimental Forest than is reflected in the THP database (as shown on Britting 2003, Map 2). The areas delineated in green on Map 3 (Britting 2003) are those that were approved for clear cutting prior to 1990 in the Gaddis Creek sub-basin (Basin 24). In several cases though, the approved harvest did not occur until 1993. These previously clear cut areas were combined with the areas approved for clear cutting in the THP database. Clear cutting harvest occurred or was approved between approximately 1987 and 2002 on 26% of the Gaddis Creek sub-basin. Britting 2003, Table 3). When the clear cut areas are considered with respect to private lands alone in this sub-basin, the portion harvested or approved for clear cutting ranges from rises to 36% for the fifteen year period. As with the region to the south (Britting 2003, Map 1), continuation of this rate of harvest would result in the entire sub-basin being clear cut within 50 years.

An aerial photo of the western portion of the Gaddis Creek sub-basin taken in November 2002 verifies that at least three age classes for plantations exist in the sub-basin. (Britting 2003, Map 4). This pattern is repeated in the sub-basin to the north as well as sub-basins to the west.

The most recent THP submitted in the Gaddis Creek sub-basin (area depicted in Britting 2003, Maps 3 and 4) was reviewed. The Buckshot THP (4-00-82/ELD-44) was submitted in 2000 and includes 533 acres of clear cutting in the Gaddis Creek sub-basin. This THP identifies the presence of two owl territories in the Gaddis Creek sub-basin. Further, the THP reports that since 1996, CSO has not been sighted in this area. The SPI data base on owl sightings identifies three territories in the sub-basin. The sighting history for these owl territories (Britting 2003, Table 4) suggests that as clear cutting harvest increased in this sub-basin and the surrounding areas, owl activity that had been noted previously was absent.

D. Logging in Southern California

Though logging in southern California occurred over a shorter period of time and was less intensive than in the Sierra Nevada, it still has negatively affected spotted owls in southern California. Further, because forests in southern California occur on isolated and relatively small mountain islands and support exceedingly small populations of owls, even limited logging has potentially affected population viability. Logging began in southern California at the turn of the century in the western part of the San Bernardino Mountains and served the growing city of Los Angeles. Minnich et al. (1995) documented that several of 68 vegetation plots first measured in 1929 and then re-measured in 1992 were logged prior to the turn of the century. These plots were recorded as young-growth stands in the 1929 survey and were dominated by large numbers of small trees. These stands remain largely in the same state today. Minnich et al. (1995) state:

> "For logged mixed ponderosa pine forest, old photographs and diaries of lumberman indicate that old growth stands logged in the western SBM consisted of large individuals (dbh = 2-3 m) of all species. When surveyed by VTM, they were dense stands of regenerating ponderosa pine mainly smaller than 33 cm, mixed with abundant white fir and incense cedar and scattered sugar pine, similar to modern mixed conifer forests… By 1992, density of trees on these logged sites had risen to 378 per ha, still dominated by a cohort smaller than 33 cm dbh."

Thus forests logged at the turn of the century have still not recovered, resulting in loss of habitat that persists today. Detailed records of logging in southern California date back to 1940—a year when four sawmills were active in San Diego and San Bernardino Counties and approximately 18 million board feet was harvested (May 1953). From 1940 till 1977,

annual harvests ranged from .5-27 million board feet, mostly from Los Angeles and San Bernardino Counties, but also Riverside and San Diego Counties (May 1953, Waddell and Bassett 1997). In total, 362.3 million board feet have been removed from Los Angeles and San Bernardino Counties since 1947 with harvesting occurring on both public and private lands (McKelvey and Johnston 1992, Waddell and Bassett 1997). Speaking of southern California forests, McKelvey and Johnston (1992) conclude:

> "In the period after World War II, forest structures would have been significantly altered where timber was logged. Because logging would have been concentrated on sites with higher productivity, it undoubtedly impacted spotted owl habitat, though we cannot determine the extent of that impact."

Until recently, harvest has remained below two million board feet and has been zero or less than a million board feet in most years since 1981 (Waddell and Bassett 1997).

Beginning in 1999 and continuing to the present, a severe drought in southern California, in combination with diseases, insects and likely air pollution, has led to extensive tree mortality on roughly 500,000 acres concentrated in the San Bernardino, San Jacinto and Palomar mountain ranges (USDA 2004b). It is unknown what the impact of this mortality is on California spotted owl habitat. According to the Forest Service, areas of high tree mortality are at risk of stand-replacing fires and such fires are the greatest threat to the California spotted owl. In response, they have proposed to conduct extensive salvage logging and thinning in southern California national forests. Such logging presents a substantial threat to the California spotted owl in southern California. USDA (2004b), for example, concluded:

> "spotted owls are subject to loss of habitat from fuels management for community protection, community development and associated infrastructure on and off the forest, as well as human disturbance and habitat loss from a variety of uses and activities. Under all alternatives, fuels treatment work will be accelerated. In the short term all alternatives will emphasize treatment of areas (particularly around communities) affected by high levels of vegetation mortality that has resulted from recent drought and insect outbreaks. Over the longer term, treatments would focus primarily on community protection under alternatives 1, 2, 4 and 5."

Vegetation treatments are in various stages of planning on more than 200,000 acres in the four forests. On the San Bernardino National Forest, for example, 16% of mixed conifer forests are planned for salvage logging. Given the fragile status of spotted owl populations in southern California, increased logging in addition to tree mortality could have a devastating impact on the species and indicates it is threatened or endangered in a significant portion of its range. USDA (2004b) concluded:

> "California spotted owl populations appear to be declining in southern California, most likely because of the recent drought and the 2003 wildfires. Alteration and loss of habitat due to tree mortality and dead tree removal will continue for many years, as will the increased risk of catastrophic fire created by high levels of tree and shrub die-off. Small populations in isolated mountain ranges could decrease or even be lost because of these factors. Furthermore, because of the extent of forest mortality and habitat degradation within the core spotted owl population area in the San Gabriel and San Bernardino mountains, the ability of this population to supply new animals to outlying locations may be reduced for some time to come."

In sum, logging and recent tree mortality has contributed and is contributing to loss of habitat for highly sensitive populations of California spotted owls in southern California.

E. Development across the range of the California spotted owl is resulting in substantial loss of habitat

Development on private lands in the Sierra Nevada and southern California presents a significant threat to the California spotted owl, particularly in low elevation riparian hardwood habitats, but elsewhere as well. In the Sierra Nevada, the human population doubled from 1970 to 1990 and is approximately four times peak populations of the gold rush (1849-1852) (Duane 1996a). Further, the population is predicted to triple from 1990 levels by 2040. Duane (1996a) found that though most of the population was concentrated in urban centers, low density, dispersed settlement affected a significant portion of the Sierra Nevada. He states:

> "Most of the new residents have settled near the historic centers of the gold rush, but modern patterns of human settlement have resulted in much more extensive land conversion. Three out of five Sierran residents lived on less than 300 mi^2 (less than 1%) in 1990, but human settlement was spread across nearly 1,741 mi^2 at an average density of at least one housing unit per 32 acres. This constituted 5.44% of the entire Sierra Nevada, or nearly 14% of all private lands (including industrial timberlands)."

Most of this development is occurring in the foothills east of major urban centers, such as Sacramento, and major thoroughfares, such as Highways 49 and 50 and Interstate 80. The highest housing densities, for example, are found in Nevada, Placer, Eldorado and Amador Counties, which are all roughly due east of Sacramento and near all three major highways mentioned above (Duane 1996a). Because of these highways and increasing numbers of long distance commuters, the foothills have experienced the most conversion for human settlement. In terms of the California spotted owl, this is significant both because owls nest in low elevation riparian hardwood forests and because Laymon (1988) found that a proportion of territorial owls migrate down to foothill areas during the winter. Though there is no data on the proportion of such areas that are being developed, clearly development is occurring and in fact Laymon (1988) observed owls roosting near new housing developments in riparian canyons.

The Forest Service and other Federal agencies also conduct projects to maintain infrastructure for a growing population. A number of general projects, such as powerline maintenance and road construction, that resulted in determinations of affect on individual spotted owls, as discussed above, are essentially development projects to support a growing population.

Though foothill woodlands have been the most severely altered, all forest types have been affected. McBride et al. (1996) measured forest conditions in both developed and undeveloped areas in various forest types, including red fir-lodgepole pine, mixed conifer, ponderosa pine and foothill woodland. They found that in all forest types human settlement reduced tree canopy cover and density, stating:

> "Construction of structures, roads, and other infrastructure elements in forests often necessitates the removal of trees and results in reduction of canopy cover and tree density. Trees may also be removed to facilitate access to sunlight, especially in more densely wooded areas. Conversion of tree cover to lawn also contributes to the decrease in tree canopy cover and density."

Canopy cover in mixed conifer was 92% in control areas compared to 64% in developed areas (McBride et al. 1996). Similarly, in ponderosa pine, canopy cover was 90% in control areas compared to 62% in developed areas. The more concentrated the development

the greater the proportion of converted land. McBride et. al. (1996) found that in areas where lots were one acre, a greater proportion (41%) of the surface area was covered by impervious materials, such as structures and roads, than in either the three to five acre or 10 to 20 acre lot sizes. These larger lot sizes both had approximately 7.5% of the area covered by impervious material. Thus, as with logging development reduces the density and cover of forests, and when combined with the disturbance from noise, traffic and other human activities (see Wasser et al. 1997), is counter to maintaining owl habitat and territories.

F. Livestock grazing

Though the direct effects of livestock grazing on the California spotted owl have not been studied, grazing is likely to indirectly affect the owl by reducing or eliminating riparian vegetation utilized by the owl in portions of its range; by altering forest structure and fire regimes in both ponderosa pine and mixed conifer forest types; and by reducing the density of potential spotted owl prey items. Both the Sierra and Tahoe National Forests, for example, have determined that issuance of grazing permits "may affect individual California spotted owls, but will not likely lead to a trend towards Federal listing."

Numerous studies from across the west, including California, have shown that livestock grazing results in the complete loss or severe reduction of riparian forest vegetation (see Belsky et al. 1999, Smith 1989) and as a result livestock grazing is considered a prime factor in the approximately 90% reduction in these forests in the western United States (GAO 1988). As of 1992, riparian forests harbored 1.6% of all California spotted owl territories in the Sierra Nevada and 32% of all southern California territories (Verner et al. 1992). Because there are no historical estimates of numbers of territories in riparian forests, it is not possible to determine to what extent these figures represent a decline from past levels. Considering the extent of loss of riparian forests, however, it is quite likely that there has been historical loss of territories in this habitat type. Another likely impact of loss of riparian forests is increased isolation of metapopulations in southern California, as low elevation riparian forests probably once served as dispersal corridors between populations in the various mountain ranges (LaHaye pers. com.).

Livestock grazing has also been implicated in changes in forest structure and fire regime in ponderosa pine forests and mixed conifer forests in many parts of the west, including the Sierra Nevada (e.g. Madany and West 1983, Rummel 1951, Swetnam et al. 2000, Swetnam and Baison 1994, Touchan et al. 1993, Vankat 1977). Historically, the structure of ponderosa pine and mixed conifer forests in the Sierra Nevada and southern California was influenced by frequent, low intensity fires that removed understory vegetation and regeneration and favored fire tolerant species (Minnich et al. 1995, Weatherspoon et al. 1992). Following the introduction of large numbers of sheep in the 1860s and at least 30 years before the advent of fire suppression, frequent fires ceased to burn across most of the landscape (Kilgore and Taylor 1979, Swetnam et al. 2000), probably because of reduction of ground fuels, such as grass, and trailing. Cessation of fire in turn has resulted in copious tree regeneration, increased tree densities, elevated fuel loading and heightened danger of stand replacing fire, particularly in ponderosa pine forests (Weatherspoon et al. 1992). Increased risk of stand replacing fire is considered a threat to existing owl pairs across the range of the California spotted owl. The effects of current livestock grazing on fuel loads in the Sierra Nevada are currently unknown.

Lastly, livestock grazing has been documented to reduce densities of some species of small mammals in a number of different community types (Belsky et al. 1998, Hanley and Page 1982, Johnson 1982, Page et al. 1978, Schulz and Leininger 1991). Because studies have not been conducted on the effects of livestock grazing on prey species of the California spotted

owl, the specific effects of livestock on such species within the owl's range are unknown. However, given results of other studies, which showed grazing related declines in some small mammals, it seems likely that livestock grazing may be indirectly effecting the owl by reducing prey abundance.

G. Recreation

Recreation potentially affects California spotted owls in several ways, depending on the type of activity. Light recreation, such as hiking on already established trails or birdwatching, probably has very little impact on the owl. Conversely, more intense forms of recreation, such as off-road vehicle (ORV) or snowmobile use, has the potential to seriously impact the owl through noise. And indeed the Forest Service concluded that an ORV motorcycle race on the Sierra National Forest was "likely to adversely affect the California spotted owl"—the only time such a determination was made. Wasser et al. (1997) documented that male northern spotted owls near logging roads experienced more physiologic stress, which can negatively affect reproduction, survival and resistance to disease, than owls further from roads based on levels of stress hormone in fecal samples. While this study primarily focused on logging roads, the effects from noise from ORVs should be relatively the same, namely reduced fitness of individual owls. This study also indicates that more traffic throughout the Sierra Nevada on the already existing and extensive road system for whatever purpose could potentially harm owls. The infrastructure necessary for recreation is also likely to pose a significant threat to the owl. Construction of roads and trails, resort development, ski resort expansions, and others all have the potential to reduce overall habitat and disturb individual owls.

Between 1993-1998, the Forest Service concluded that a total of 60 recreation projects "may affect the California spotted owl" in the seven National Forests of the Sierra Nevada analyzed above, plus the four southern California National Forests. These projects included ski resort expansions, trail and road construction, ORV races, campground expansion and others.

Duane (1996b) estimated that there are currently 50 to 60 million "recreation visitor days" (RVDs) per year in the Sierra Nevada, of which two thirds occur on National Forest lands. These RVDs were concentrated in the southern and central Sierra, where the most effects on owls were also noted. Duane (1996b) states:

> "The Inyo, Sequoia and Sierra National Forests—each of which is adjacent to at least one of the national parks in the southern and central Sierra Nevada—account for 45% of all RVDs on the USFS lands in the Sierra Nevada. Together with the national parks, this portion of the Sierra Nevada probably represents one of the highest level of recreational activity in the entire world… The Lake Tahoe Basin represents a similar focal point for recreation in the Sierra Nevada, with much of the recreational activity on the Tahoe National Forest, the Eldorado National Forest and the Toiyabe National Forest occurring in association with activities in the Lake Tahoe Basin Management Unit."

Considering that the population of California is expected to double or even triple by 2040 (Duane 1996a), recreational activities are likely to also grow, resulting in further loss of habitat and disturbance to the owl. Duane (1996b) noted that just because population doubles or triples does not necessarily mean there will be twice as many RVDs, but also concluded:

> "Even without a proportionate doubling of demand, however, conflicts are likely to increase between recreational activities and other uses of public lands and resources."

VI. Other natural or manmade factors affecting the continued existence of the California spotted owl

A. Weather

Weather has been identified as one probable cause of declining owl populations by several researchers, who determined that poor weather can depress fecundity (Steger et al. 1999, Gutiérrez et al. 1999, Verner 1999, LaHaye et al. In press). And indeed Franklin et al. (2000), in an extensive demographic study of the northern spotted owl in northern California, demonstrated a negative relationship between reproductive output and precipitation during the late nesting period. As stated elsewhere, however, it is unlikely that climate is the sole or primary cause of decline because adult survival, and not fecundity, primarily determines the finite rate of population change (λ). Though adult survival is to a certain extent also affected by weather, Franklin et al. (In press) found that habitat quality was the primary determinant of survival and that high quality habitat buffers the effects of climate on this demographic parameter. They conclude:

> "Habitat quality, as defined by fitness, appeared to buffer variation in annual survival but did not buffer reproductive output. We postulated that the magnitude of λ was determined by habitat quality whereas variation of λ was influenced by recruitment and reproductive output. As habitat quality declines, variation in λ should become more pronounced." (Franklin et al. in press).

This suggests that habitat quality, and not climate, through its effect on annual survival primarily determines whether a population is declining, stable or increasing (see above comparison between Sequoia/Kings Canyon National Parks and Sierra National Forest for additional support for this conclusion).

This is not to say that climate is not important, however. To the contrary, by contributing to variation in λ, weather potentially increases risk of extinction. Franklin et al. (In press) conclude:

> "In other words, as habitat quality decreases, density independent factors become more important in determining variation around λ… Theoretically, an increase in variation around [the mean of] λ, with a greater proportion of this variation caused by climate, will increase the probability of extinction."

In addition, risk of extinction is furthered if variation in demographic parameters and ultimately λ is correlated among different portions of a contiguous population (Schaffer 1987). Preliminary analysis indicates that reproductive success is correlated across the Sierra Nevada with good or bad reproductive years synchronized among populations in the south, central, and possibly northern Sierra (Peery 1999), likely related to fluctuation in regional weather patterns. This suggests that weather further increases risk of extinction for the owl.

Yet another way climate may increase extinction risk is through catastrophic disturbance (Franklin et al. (In press), Shaffer 1987,Goodman 1987). Catastrophic events, such as severe storms, have been found to lower survival and reproductive output (Franklin et al. In press, Steger et al. 1999). For example, Franklin et al. (In press) found that:

> "Both survival and reproductive output appear to have longer periods of relative stability punctuated by shorter periods exhibiting severe declines in both survival and reproduction, which represent catastrophic events for each of these parameters."

Additionally, Steger et al. (1999) observed lower fledgling success on the Sierra National Forest than the Sequoia/Kings Canyon National

Park in 1999 and speculated this was caused by a single storm that was measured to be more severe on the former than the latter. If the owl population continues to decline, it will become increasingly likely that such dips in survival and reproduction from catastrophic events will result in extinction (Lande 1993).

Lastly, Franklin et al. (2000) determined that because of the effects of climate on owl demographic parameters, population declines may occur even if habitat loss ceases. They state:

> "If certain long-term climate trends can cause negative rates of population change, as suggested in this study, then climatic variation has the potential to negatively affect northern spotted owl populations, even if no further habitat loss occurs."

Combined with the fact that high quality habitat, including large blocks of core old growth habitat, were found to buffer the effects of climate on survival (Franklin et al. In press) and that owls are severely declining in the Sierra Nevada, the above conclusion suggests that not only is no further loss of habitat merited, but significant habitat recovery is required. Indeed, Franklin et al. (In press) conclude:

> "This also suggested that habitat maintenance is essential when considered on landscape scales because excessive loss of key landscape habitat components, such as mature and old growth forest, can exacerbate the effects of unfavorable climatic conditions on survival."

B. Fire

It is widely recognized that historic forest structures in many western forest types were heavily influenced by frequent fires, including ponderosa pine and mixed conifer forests in the Sierra Nevada, and that loss of fire from these systems because of livestock grazing, fire suppression and other factors has resulted in changes in forest structure (Covington and Moore 1994, Kilgore and Taylor 1979, Swetnam and Baison 1994, Touchan et al. 1993, Weatherspoon et al. 1992). It is also well recognized that increased fuel loadings, related to these changes, have increased the likelihood of large crown fires in these forest types (Verner et al. 1992). Such fires pose some risk to existing owl territories.

While it is clear that there is a risk that owl territories will be destroyed by crown fire in the future, it is important to recognize that much of the owl population occurs in portions of the landscape that are not the highest risk and that not all fires destroy owl habitat. Weatherspoon et al. (1992) state:

> "Countryman's (1955) description of fuel conditions within old growth stands applies in large measure to fuel conditions within many mixed conifer stands used by the California spotted owl. These stands are less flammable under most conditions, because the dense canopies maintain higher relative humidities within the stands and reduce heating and drying of surface fuels by solar radiation and wind."

Fire frequencies in mixed conifer forests of the Sierra Nevada historically ranged from 5-80 years (Swetnam et al. 2000). Many of the existing owl sites and much owl habitat occurs in areas where fire frequencies are at the higher end of this range, including canyon bottoms and north slopes (Gould 1977, Weatherspoon et al. 1992). Further, not all fires in owl habitat will result in territory abandonment even when they are quite large. Bond et al. (2002) documented the fate of 21 color-banded spotted owls following fires that burned through both the nesting and roosting stand and concluded:

> "Relatively large wildfires that burned nest and roost areas appeared to have little short-term effect on survival, site fidelity, mate fidelity, and reproductive success of spotted

owls, as rates were similar to estimates independent of fire."

Thus, the likely risk to owls from fire is presently undetermined and probably overstated, particularly considering that risk of severe fire may be remaining constant over time. Though recent individual fires in the Sierra Nevada have been hotter, larger and more severe than probably occurred historically, it is important to note that area burned has not increased appreciably over the last 80 years (McKelvey and Busse 1996). This differs from the Southwest where severe fuel accumulations have resulted in less controllable fires and substantial increases in area burned, particularly in the last couple of decades (Swetnam, pers. comm.). This indicates that there is time to take a cautious approach to fuels treatments in the Sierra Nevada.

C. Barred owl

Within the last 40 years, the barred owl (*Strix varia*) has been expanding its range south from Canada, occupying the entire range of the northern spotted owl and moving further into the range of the California spotted owl (Dark et al. 1998, Kelly et al. 2003, Pearson and Livezey 2003). Barred owls have been continuously observed in the northern Sierra on the Tahoe National Forest since 1991 (Marilyn Tierney, District Wildlife Biologist, Downsville Ranger District, personal communication) and in 2002 a pair of barred owls and three pairs of spotted owls mated with hybrid barred-spotted owls (sparred owls) on the Lassen National Forest (USFWS 2003A). Based on ecological niche models, Peterson and Robins (2003) predicted that barred owls may leave the California spotted owl relatively untouched not invading further south than 38° N latitude. In 2004, however, a barred owl was observed in Sequoia National Park (Steger personal communication, July 19, 2004), suggesting the species' range is continuing to expand southwards past the predictions of Peterson and Robins (2003). Barred owls have also been observed on the Eldorado and Plumas National Forests as well (Mark Seamans personal communication, July 20, 2004). Following first occurrence, barred owls have in many areas increased rapidly in density (Kelly et al. 2003, Gremel 2003, Pearson and Livezey 2003).

Barred owls are larger and more aggressive than spotted owls and have been documented to displace them from territories (Dark et al. 1998, Kelly et al. 2003, Gremel 2003, Pearson and Livezey 2003). Recent research on the northern spotted owl suggests that such displacement is common and is sufficient to negatively impact spotted owl population numbers (Kelly et al. 2003, Gremel 2003, Pearson and Livezey 2003). Barred owls also hybridize with spotted owls, leading to loss of genetic diversity and potentially genomic extinction in the long-term (Allendorf et al. In press). Because barred owls are habitat generalists and do well in logged areas, logging may be part of the cause of their spread (Dunbar et al. 1991, Dark et al. 1998, Pearson and Livezey 2003).

Despite recognizing that "barred owl populations in California are increasing" and that they "have been documented to displace spotted owls from their territories," the U.S. Fish and Wildlife Service in their decision to not protect the California spotted owl concluded:

> "Although barred owls may pose a substantial threat to California spotted owls at some point in the future, by themselves, or in combination with other factors, they do not nor do other factors seem to pose now or in the foreseeable future a significant threat to the continued existence of the California spotted owl such that it warrants listing." (USFWS 2003A)

Besides being internally contradictory, this conclusion has little support. Barred owls have rapidly increased in range and density and are a known threat to the continued existence of spotted owls where they co-occur. The current trend suggests that they are continuing to move

further south. No information suggests that this trend is slowing or stopping. In the absence of such information, the only rationale conclusion is that barred owls represent a substantial threat to the California spotted owl in the foreseeable future. Such a conclusion clearly indicates the California spotted owl warrants listing.

VII. Disease and Predation

Predation. Known predators of spotted owls include the great horned owl, northern goshawk, red-tailed hawk and barred owl (Forsman et al. 1984, Leskiw and Gutiérrez 1998, and see Gutiérrez et al. 1992). Of these, the great horned owl is likely the most common. Because great horned owls tend to forage in forest openings (Johnson 1992), reducing canopy cover or creating breaks in the forest canopy by logging may expose owls to a heightened risk of predation (Peery 1999). Avian predation resulted in 40% of observed mortalities of northern spotted owls (Bart et al. 1992), indicating predation potentially affects population stability by lowering survival.

West Nile Virus. West Nile Virus (WNV) was first detected in the United States in 1999 in New York and has rapidly spread across the country, including several locations throughout the Sierra Nevada in 2004 (SYMVCD 2004). The virus is spread by mosquitoes to multiple species of birds, many of which form the primary host, and many species of mammals, which are infected but don't produce viremia (CDC 2004). Bird species differ in their response to the virus with some acting as carriers, but not showing symptoms of infection, and others experiencing substantial mortality (NAS 2004). WNV has yet to be detected in spotted owls in the wild, but resulted in mortality of a captive bird, indicating the disease will infect and kill spotted owls (CDC 2004). The few studies on the effects of WNV on bird populations that have been conducted indicate that the disease can suppress populations (see NAS 2004). The continuing spread of West Nile virus presents a serious potential threat to the California spotted owl and needs to be monitored closely. Blood samples of California spotted owls were collected during the 2004 field season and will be analyzed for WNV Fall, 2004.

VIII. The inadequacy of existing regulatory mechanisms to protect the California spotted owl

Several facets of the California spotted owl's biology are important to consider when determining the adequacy of existing regulations. First, because the owl compensates for low and highly variable fecundity with a long life, survival of adult owls has the greatest impact on population trajectory (Noon and Biles 1990) and effective regulations must ensure adult survival is not compromised. A number of studies indicate that this can be accomplished through maintenance of large blocks of suitable habitat (Franklin et al. In press, Noon and Blakesley 1999). Noon and Blakesley (1999), for example, observed that:

> "In a mathematical context, the finite rate of population change (λ) is most affected by the mean and variance of the survival rate of owls $\geq$1 year old (Noon and Biles 1990)… To the extent that survival rates are affected by habitat loss and fragmentation, changes in management practices may lead to increases in survival" (Noon and Blakesley 1999).

Second, because dispersal by juveniles and adults in search of mates and territories entails a great deal of risk, increasing nearest neighbor distance between owl territories through habitat loss and fragmentation will contribute to increased mortality and population decline. Noon and Blakesley (1999) state:

> "Future management activities, for example, should not increase the mean nearest-neighbor distance among suitable owl pair sites. Management activities which reduce population density by lowering habitat quality or

> increasing fragmentation will increase the uncertainties associated with successful dispersal and mate finding."

Thus, any management actions targeted towards protecting owl habitat and owl population viability should be considered in the context of their ability to provide both quality habitat within individual home ranges and contiguous habitat across the landscape. As demonstrated below, current regulations on both Forest Service and private lands fail on both counts.

A. The 2004 Sierra Nevada Framework revision fails to protect the California spotted owl and its habitat on Federal lands.

Management of the California spotted owl and its habitat on national forest lands is governed by the 2004 Record of Decision (USDA Forest Service 2004a, hereinafter cited as "2004 ROD"), which revised the 2001 Sierra Nevada Forest Plan Amendment (USDA Forest Service 2001b, hereinafter cited as "2001 ROD"). As demonstrated in the administrative appeal and supporting exhibits filed with the Chief of the Forest Service on behalf of the Sierra Nevada Forest Protection Campaign, the Center for Biological Diversity, and other organizations (2004), the 2004 ROD threatens the owl's viability and distribution on national forest lands. Virtually all of the expert reviewers, including owl experts and federal and state agencies, expressed major concerns regarding the impacts of the 2004 ROD on the owl.

The leading spotted owl biologists have been uniformly critical of the 2004 ROD, concluding that the plan threatens the owl's viability and contributes to a trend towards federal listing under the Endangered Species Act (Verner 2003; Blakesley and Noon 2003; Noon 2004; Peery 2004; Bond 2003; Franklin et al. 2004) and urging the Forest Service to withdraw the plan and to implement the 2001 ROD or a similar approach (Noon 2004; Verner 2004; Blakesley and Noon 2004). The Forest Service's internal reviewers found that the 2004 ROD "likely incurs greater risk to owl persistence" than the 2001 ROD (Stine and Keane 2003, p. 9), and the agency's Washington Office Director of Fish and Wildlife stated "one can only conclude that standards in [the 2004 ROD] are a prescription for continued owl population declines." (Gladen 2003, p. 11). Other agencies, including the U.S. Environmental Protection Agency (2003b) and the California Resources Agency (2003), also expressed significant concerns about the impacts of the 2004 ROD on the California spotted owl; the EPA concluded that the plan's impacts "appear inconsistent with the underlying SNFPA purpose and need to … prevent listings of old forest-dependent species." (U.S. Environmental Protection Agency 2003, p. 4).

In its 2003 decision that the owl did not merit listing, the Fish and Wildlife Service acknowledged that the Forest Service was in the process of amending the 2001 ROD, and that the amended decision "could have more widespread impacts on California spotted owl habitat." (USDI Fish and Wildlife Service 2003a, p. 7596). However, the Service stated that "because such proposals are not incorporated in established management direction, they remain outside the scope of this finding." (Ibid.). The Fish and Wildlife Service has subsequently expressed the following written concerns regarding the 2004 ROD:

> "We have concerns about projected declines in owl habitat under S2 [the 2004 ROD], especially projected declines in preferred nesting habitat within the first 20 years of implementation. Treatment to the forest-wide standards and guidelines for fuels treatments would increase uncertainty that the amount and quality of habitat available will be enough to provide for viable owl populations" (USFWS 2003A, p. 2, emphasis added).

> "We are concerned that subtle changes in analysis and scale between Alternatives S1 [the 2001 ROD] and S2 [the 2004 ROD] will have significant effects on old forest

habitats used by the owl…. These changes would allow reduction of structural complexity within treated habitats, which reduces certainty that sufficient structural complexity will be retained in California spotted owl habitat." (Ibid., pp. 4-5).

The Service recommended that "all stands of [CWHR class] 5M, 5D, and 6 large enough to serve as nest stands be protected" so that stands of potential owl nesting habitat could not be removed, "reducing habitat available for colonization by dispersing owls." (Ibid., p. 5). This recommendation was not adopted in the 2004 ROD.

With respect to the 2004 ROD's full implementation of the Quincy Library Group project, the Service stated that "these changes in S2 create greater uncertainty that sufficient habitat will be retained for the California spotted owl." (Ibid., p. 8). In its earlier critique of the QLG proposal, the Service stated: "The Service believes the implementation of [the QLG project] poses a significant threat to the long-term viability of the California spotted owl … due to the loss, degradation, and fragmentation of suitable habitat." (USDI Fish and Wildlife Service 1999, p. 16, emphasis added).

For the following reasons, the 2004 ROD fails to conserve the California spotted owl and is likely to further degrade the owl's habitat on national forest lands in the Sierra Nevada.

1. Logging of medium and large trees.

The 2004 ROD (p. 50) increases logging diameter limits from the pre-existing 12-20" to 30" in all land allocations. However, research indicates that 20-30" diameter trees are an important component of owl foraging and nesting habitat. For example, Call et al. (1992) showed that owls strongly select stands with a high basal area of trees between 20.7-35.4 inches for foraging. In fact, the basal area of trees in this size class was the second most important variable (out of 54) for discriminating owl foraging stands from random stands. Bias and Gutiérrez (1992) found that a greater basal area of trees in the 20.7-35.4 inch size class occurred in owl nest stands than in random stands. Blakesley (2003) documented greater nest success in stands and greater survival in territories dominated by medium and large trees. The 1992 CASPO report found that nearly 25 percent of owl nest trees were less than 30" dbh. (Verner et al. 1992, p. 92). In sum, as the Fish and Wildlife Service has expressed in a related context, "a significant number of potential nest trees could be removed" by logging trees less than 30" dbh. (USDI Fish and Wildlife Service 1999, p. 7).

The Fish and Wildlife Service has found that removal of trees larger than 20" dbh "may reduce numbers of existing and potential nesting trees and large diameter snags and logs, with an accompanying reduction of canopy cover." (USDI Fish and Wildlife Service 2003a, p. 7600).

Dr. Barry Noon, in his review of the plan, described the proposal to log trees up to 30" dbh as "perhaps one of the most poorly justified components of the new management plan." (Noon 2004, p. 2). "Not only does this exacerbate unnatural stand structures by further reducing the number of large diameter trees and put old growth wildlife species at increased risk, it is not a justified priority under any scientifically credible fuels reduction plan." (Ibid.). "Without any information to the contrary, management plans should assume that 20-30 inch trees constitute an important component of Spotted Owl habitat and that removing significant numbers of these trees could have a negative effect on Spotted Owl population viability." (Peery 2004, p. 2; Bond 2003).

Removing trees under 30" diameter also has the effect of "making large tree recruitment in the future more uncertain," according to the Forest Service's Washington Office. (Gladen 2003, p. 11). Owl scientists have similarly concluded that the new plan "fails to ensure adequate

recruitment of large trees, which are a critical component of owl nesting habitat, once the stock of mature and old-growth trees becomes reduced due to natural mortality." (Peery 2004, pp. 2-3; Verner 2003, p. 3).

2. Reduction in canopy cover and simplification of multi-layered canopies.

The 2004 ROD reduces the Framework's canopy retention standards from 50 percent to 40 percent (or possibly even lower in some circumstances), while also increasing the amount of canopy reduction allowed from 10-20 percent to 30 percent.[4] The reduction in the standard from 50 percent to 40 percent represents a substantial departure from the Framework, one that owl scientists do not support. (Verner 2003; Blakesley and Noon 2004; Peery 2004). According to Verner (2003b, p. 2), reducing canopy cover to 40 percent "would markedly reduce the suitability of owl habitat, with much uncertainty about the overall effects on the owl population." The effect is to reduce canopy cover in primary owl habitat "to levels providing only marginal habitat, or worse, for foraging and clearly unsuitable for nesting." (Verner 2004, p. 3).

The Fish and Wildlife Service has found that reducing canopy cover to 40 percent in timber types selected by owls results in "degradation of suitable nesting and roosting habitat" for owls. (USDI Fish and Wildlife Service 2003a, p. 7604).

The Review Team justified lowering allowable canopy levels by arguing that dense canopy is not as important as assumed in the FEIS (USDA Forest Service 2003, pp. 37-40). They justify this based in part on Lee and Irwin (In review), which reanalyzed data from Hunsaker et al. (2002), finding that productivity was in fact positively related to increasing canopy cover, which influenced nesting probability, but that other factors, such as weather, exerted a greater influence over owl reproduction. These results are consistent with a number of other studies that found that variation in site occupancy and apparent survival are most influenced by habitat, but that variation in fecundity is more influenced by weather and other factors, although site quality is also important (Franklin et al. 2000, Blakesley et al. In press). In relatively long-lived species, like the spotted owl, however, it is apparent survival that exerts the greatest influence on population trend (Noon and Biles 1992). As Lee and Irwin's findings relate to productivity, they fail to justify a strategy that is likely to lower site occupancy and apparent survival by lowering canopy cover and thereby negatively influence population trend. This conclusion is supported by several prominent owl scientists. Noon and Blakesley (2004), for example, concluded:

> "Finally, the FSEIS [for the 2004 Framework revision] misinterprets a new, unpublished study by Lee and Irwin with respect to the effects of thinning on spotted owl persistence and discounts our research on spotted owl habitat relationships on the Lassen National Forest. It is well known that there is high variation in annual rates of reproduction by California spotted owls, which is probably influenced by fluctuations in prey availability, weather, and other factors… More importantly, trends in fledgling production do not correspond directly to trends in numbers of territorial spotted owls, as implied in the FSEIS characterization of Lee and Irwin's paper ('Trends in population numbers will respond far more dramatically to the frequency of good years than changes in site quality.'). Spotted owls are long-lived animals that reproduce infrequently compared to shorter-

[4] Although the plan would ostensibly retain 50 percent canopy cover as a goal, it would allow canopy cover to be reduced to 40 percent whenever "project objectives require additional canopy modification," such as to "design cost efficient treatments." (2004 ROD, p. 51). Moreover, the ROD also states that "where existing vegetative conditions are at or near 40 percent canopy cover, projects are to be designed [to] remove the material necessary to meet fire and fuel objectives." (Ibid., p. 50). The implication of this standard is that canopy cover can be reduced to below 40 percent in such situations, where necessary "to provide for an effective fuels treatment." (Ibid.).

lived birds. Trends in population numbers of territorial owls are influenced by survival of territorial owls, survival of non-territorial owls, including fledglings, and by fledgling rates. Furthermore, our research showed that habitat quality did influence spotted owl site occupancy, survival, and reproduction."

This conclusion is also supported by the Fish and Wildlife Service, who noted that both Hunsaker et al. (2002) and Lee (2001) "found that canopy cover of at least 50 percent was desirable" (USDI Fish and Wildlife Service 2003a, p. 7601).

Owl scientists have consistently emphasized the need to "increase retention and recruitment of large trees and retention of closed canopy conditions throughout the Sierra Nevada landscape." (Blakesley and Noon 1999, p. 24). The 2004 ROD is plainly inconsistent with these recommendations. As stated in the DSEIS, "potentially more open overstory can be created with Alternative S2 than with S1" (DSEIS, p. 190), the effect of which will be to degrade owl nesting and foraging habitat. According to the Forest Service's Washington Office Director of Fish and Wildlife, the new plan's canopy cover limits provide "at best marginal habitat, less preferred by owls resulting in less productivity than stands of 50% or more canopy closure." (Gladen 2003, p. 10).

In addition, several studies have identified canopy layering as an important structural characteristic associated with preferred foraging sites for the northern spotted owl. (USDA Forest Service 2001a, Volume 3, Chapter 3, part 4.4, p. 72). North et al. (2000) also found that high foliage volume was a key factor in selection of nest sites for spotted owls on the Sierra National Forest. The effect of the new plan will be to simplify the canopy, promoting forests with little or no understory, "which could affect owl reproductive output." (DSEIS, p. 187).

3. Removal of large snags and down wood.

Large snags and large woody debris on the forest floor have been repeatedly documented to be important components of habitat selected by California spotted owls. (Verner et al. 1992, p. 96; see Bond 2003 for a summary of research.) The new plan weakens the Framework's retention standards for snags and down wood in at least two important respects. First, the Framework's minimum standards have become discretionary "general guidelines" and can be modified at the individual project level without any apparent criteria to guide this decision. (ROD, p. 51). In other words, the plan no longer establishes minimum snag and down wood retention standards and it is reasonable to assume that retention levels for individual projects will be lower in some cases. Second, within OFEAs, the Framework's even stronger snag retention standards have been eliminated. As summarized by Bond (2003, p. 11), "large trees, snags, and large down woody debris are a vital component of old forest ecosystems," and "it is therefore inappropriate to remove large trees and snags and reduce canopy cover from any potential spotted owl habitat."

4. Increased logging within PACs.

Verner et al. (1992) considered the establishment of PACs around all known owl nest sites to be a critical component of a management strategy designed to stabilize owl habitat and populations. "The PACs were designated by the CASPO team as a means of preserving the high canopy cover so consistently associated with owl nesting sites." (Verner 2003, p. 7). "The loss of available nest sites … may preclude population expansion following breeding pulses. This, in turn, may result in declining populations with lower likelihood of persistence over time." (USDA Forest Service 2001a, Volume 3, Chapter 3, part 4.4, p. 84). The owl scientists have repeatedly cautioned the Forest Service not to conduct logging within PACs, at least until further research on the impacts of such logging is undertaken. (Blakesley and Noon 2004, p. 2). Therefore, "PACs should be viewed as 'centerpieces' of protected habitat for Spotted Owls in the Sierra

Nevada and should not be rendered unsuitable by management activities." (Peery 2004, p. 3).

The 2004 ROD significantly increases the potential adverse impacts to PACs from logging. The Framework only allowed logging in PACs within the defense zone of the WUI, whereas the new plan allows logging in PACs within both the defense and threat zones. In addition, the plan allows a greater number of PACs to be entered by allowing 10 percent of PAC acreage to be logged per decade, whereas the Framework allowed 10 percent of the total number of PACs (by number, rather than by acreage) to be entered by logging per decade. (FSEIS, p. 264). Consequently, the FSEIS projects that the plan would treat approximately 80 more PACs within the next two decades than would the Framework (FSEIS, p. 266), including more logging within the PACs (FSEIS, p. 265).[5]

Under the new plan, PACs within the defense and threat zones can be logged pursuant to the standards and guidelines for mechanical thinning treatments in mature forest stands. Yet the DSEIS concedes that such logging "could result in removal of habitat attributes that provide quality nesting and foraging habitat" for owls. (DSEIS, p. 186). "Allowing this much of the owl's core nesting habitat to be logged significantly increases the likelihood that the owl's distribution and population will decline." (Peery 2004, p. 4). As stated by Dr. Verner: "In my professional opinion, to degrade this attribute of the PACs [i.e., canopy cover] would be a major risk for the owl." (Verner 2003, p. 7).

5. Weakening protection for owl home range core areas (HRCAs) and old forest emphasis areas (OFEAs).

The new plan negates the value of HRCAs and OFEAs, which were designated in the 2001 ROD to protect and restore habitat for the owl and other old forest associated species, by applying the same logging standards and guidelines to these areas as to general forest. "The new plan would eliminate meaningful protection for HRCAs, OFEAs, and all old growth stands of 1 acre or larger by allowing the same kind of logging within these areas as within the general forest" (Peery 2004, p. 4). As stated by the Science Consistency Review, "it does not appear that land allocations such as OFEAs and HRCAs have any meaning under S2 because a single thinning prescription will be used" (Stine and Keane 2003, p. 5).

The Framework strictly limited logging within HRCAs based on the recognition that spotted owls preferentially use core areas within their home ranges (Bingham and Noon 1997) and that degrading habitat within HRCAs will likely reduce survival and reproductive success (Bart 1995; USDA Forest Service 2001a, Volume 3, Chapter 3, part 4.4, pp. 92-93). As stated in the Framework FEIS, "increasing the number of owl sites with desired amounts of habitat is likely important to stabilizing current population declines." (Ibid., p. 92). The FSEIS recognizes that "California spotted owl occurrence and productivity appears to be significantly correlated with canopy cover composition within own home ranges." (FSEIS, p. 270). Yet 2004 ROD allows logging in owl home range core areas pursuant to the same standards used in general forest, which "could result in the removal of habitat attributes that provide quality nesting and foraging habitat." (FSEIS, p. 270). The FSEIS projects that 20 percent of total HRCA acres would be logged within the first two decade (FSEIS, p. 270), though nothing in the new plan would prohibit even more logging. As the Forest Service has concluded, the new plan "would reduce the amount of multi-story canopy, stand complexity and canopy closure" within owl home range core areas, "which could affect owl reproductive output." (DSEIS, p. 187).

[5] In fact, the actual amount of logging within PACs could be significantly greater than forecast in the FSEIS, since the FSEIS predicts that only 4 percent of PAC acres will be logged over twenty years (FSEIS, p. 266), whereas the ROD explicitly allows 20 percent of PAC acres to be logged over the same time period.

The new plan's removal of protection for old growth stands of 1 acre or larger has been criticized by the Fish and Wildlife Service and by the Forest Service's Washington Office. The Washington Office specifically cited this weakening of the Framework as a factor in its conclusion that the new standards "do not maintain owl habitat and substantially increase the risk that self sustaining owl populations will not be maintained." (Gladen 2003, pp. 10-11). According to the Fish and Wildlife Service, this change may "have significant effects on old forest habitats used by the owl" by allowing "reduction of structural complexity within treated habitats," which "could allow stands of potential owl nesting habitat to be removed" (USFWS 2003b, pp. 4-5).

6. Increased logging within geographic "areas of concern."

The 2004 ROD allows significant habitat degradation within the "areas of concern" (AOCs) identified by Verner et al. (1992). These are vulnerable areas where habitat is already fragmented, threatening the owl's distribution and range. Verner et al. (1992) expressly cautioned against increasing fragmentation in the AOCs. Yet the FSEIS acknowledges that the new plan "increases risk of continued declines in owl density within areas of concern due to more intensive thinning based on application of the forest-wide standards and guidelines for mechanical treatments in mature forest stands and HRCAs. This increases the risk identified for widening gaps between habitat parcels, potentially resulting in reduced owl densities and reduction in distribution of owls and owl habitat in AOCs." (FSEIS, p. 272, emphasis added).

More specifically, the FSEIS projects that logging could occur in an additional 52 PACs within the AOCs under the new plan. (FSEIS, p. 274). As acknowledged in the DSEIS, such logging would result in a "low probability of retaining important structural attributes of spotted owl habitat." (DSEIS, p. 189). According to Dr. Verner, "the concern is that these areas might impede easy and safe dispersal of the owls throughout the Sierra Nevada, potentially affecting overall viability of the population." (Verner 2003, p. 4). For this reason, the plan "could significantly affect the owl's dispersal and reduce recruitment into the territorial population, potentially leading to the isolation of subpopulations and a reduction in the owl's distribution." (Peery 2004, pp. 4-5).

7. Full implementation of the Quincy Library Group (QLG) pilot project.

The 2004 ROD allows full implementation of the Quincy Library Group pilot project, despite the fact that both the Forest Service and the Fish and Wildlife Service have previously determined that full implementation of the QLG project would threaten the viability of the California spotted owl and other species.[6]

The Forest Service prepared an EIS and biological assessment/biological evaluation (BA/BE) to analyze the impacts of implementing the QLG project, which found that the project would significantly degrade owl habitat. (USDA Forest Service 1999b). The BA/BE concluded as follows:

Alternative 2 [the pilot project] would reduce the amount of California spotted owl … nesting habitat by 7% over the life of the pilot project, and reduce the amount of foraging habitat by 8.5%. Such reductions in suitable habitat would decrease the number of owl home ranges with more than 50% suitable habitat by 11% over the term of the project. Alternative 2 also rated the lowest among the alternatives in minimizing habitat fragmentation and impacting spotted owl Areas of Concern.

> In light of the recent demographic studies showing declining spotted owl populations, such impacts to owl habitat could pose a serious risk to the viability

[6] The Herger-Feinstein Quincy Library Group Forest Recovery Act specifies that the project can only be implemented "consistent with applicable Federal law" (Section 401(c)(3)) and that nothing in the Act "exempts the pilot project from any Federal environmental law." (Section 401(l)).

of the owl in the planning area, thereby making the implementation of Alternative 2 inconsistent with the National Forest Management Act and its implementing regulations.

In order to minimize the threat to the viability of the owl in the planning area, it is necessary to add mitigation, beyond the minimum CASPO interim guideline requirements to maintain suitable habitat within the planning area. (USDA Forest Service 1999a, emphasis added).

The BA/BE therefore recommended that "no timber harvesting … be permitted in suitable owl habitat unless and until a new owl strategy for the Sierra Nevada is released." (Ibid.).

The U.S. Fish and Wildlife Service reviewed the QLG project in response to the Forest Service's request for comments and consultation. (USDI Fish and Wildlife Service 1999). The Fish and Wildlife Service expressed concerns "that the proposed action will negatively affect spotted owl survival and/or reproduction for the following reasons: (1) habitat loss, (2) habitat fragmentation, and (3) changes in prey base." Specifically, the Fish and Wildlife Service set forth the following concerns:

> "The Service is concerned that loss of spotted owl habitat will occur through DFPZ construction, thinning, individual tree selection and group selection treatments." (pp. 6-7)
>
> Protecting only PACs and SOHAs "may result in the loss of suitable habitat in a significant portion of an owl's home range and in dispersal habitat outside and between home ranges. The Service agrees that management actions that reduce habitat suitability within home ranges can accelerate population declines." (p. 7)
>
> The project "does not take into account the juxtaposition of suitable nesting, roosting, and foraging habitat and other vegetation types, which may result in assemblages of habitat that do not promote fitness of owls." (p. 7)
>
> "A reduction in habitat quality could reduce owl densities …, limiting successful mate finding and dispersal and increasing nearest-neighbor distance." (p. 7)
>
> "The Service is concerned that reduction of suitable configurations of nesting, roosting, and foraging habitats in combination with declining populations and unforeseen contingencies (e.g., fire, disease and insect outbreaks, and drought) within spotted owl home ranges will have significant adverse effects on spotted owl population viability." (p. 8)
>
> "The Service is concerned that implementation of [the pilot project] may cause negative impacts to California spotted owls due to habitat fragmentation." (p. 9)
>
> "Due to the level of snag and large woody debris removal as proposed, the Service is concerned that [the pilot project] will remove suitable den sites and food sources of northern flying squirrels and consequently reduce the prey base for California spotted owls." (p. 10)

In sum, the Fish and Wildlife Service concluded as follows: "The Service believes the implementation of Alternative 2 poses a significant threat to the long-term viability of the California spotted owl … due to the loss, degradation, and fragmentation of suitable habitat." (USDI Fish and Wildlife Service 1999, p. 16).

The Record of Decision approving the QLG project reiterated these concerns about owl viability and adopted the mitigation measure recommended in the BA/BE. Specifically, the ROD found that fully implementing the QLG project "could pose a serious risk to the viability of the California spotted owl in the planning area." (USDA Forest Service 1999c).

The Forest Service reconsidered the impacts of fully implementing the QLG project during the process of adopting the Sierra Nevada

Framework. The FEIS again concluded that fully implementing the QLG project would significantly increase the risks to the owl, compared to the Framework alternative. In particular, the FEIS found as follows:

> "Over the 5-year timeframe of this project, there would be greater potential for increasing nearest neighbor distances between owl sites on these forests, increasing uncertainties associated with effective dispersal and mate-finding." (USDA Forest Service 2001a, Volume 3, Chapter 3, part 4.4, p. 86).
>
> "If management activities reduce owl occupancy and productivity across this area (as expected under alternative 2 of the HFQLG), opportunities to stabilize population declines could be substantially compromised." (Ibid., p. 94).
>
> "Population declines that would occur within the three geographic areas of concern located within the HFQLG project area, exacerbate the overall risk to spotted owl population…. Actions proposed under Alternative 2 of the HGQLG will widen gaps between habitat parcels and probably reduce the densities of owls within [Area of Concern 1." (Ibid.).
>
> Overall, the FEIS concluded with respect to the QLG project: "The high rates of vegetation treatments occurring over a short time period would result in substantial risk to the distribution and abundance of California spotted owls and owl habitat in the northern Sierra Nevada." (Ibid., p. 99).

Regional Forester Brad Powell, in the Framework ROD, stated his intention "to carry out as much of the [QLG] pilot project as possible." (USDA Forest Service 2001b, p. 50). However, he concluded that "the entire level of management activity specified in the HFQLG legislation cannot be implemented without degrading owl habitat without increasing risk to owl viability. The provisions for excessive canopy closure reductions, large tree removals, and substantial acreages in group selection treatments are factors contributing to this conclusion." (USDA Forest Service 2001b, p. 51).

The Forest Service now contends that the earlier findings represent a "'worst case' approach to evaluating effects of the Pilot Project on owls." (FSEIS, Vol. 2, p. 44). For example, the Forest Service questions whether all group selection and DFPZ logging under the pilot project would render spotted owl habitat unsuitable, as assumed in the previous analysis in the BE. However, there is no reason to believe that these previous assumptions were unrealistic.[7] For example, group selection would remove all trees under 30" diameter, with no protection for canopy cover. (ROD, p. 51). DFPZs only need to comply with the minimum standards in the revised Framework, such as 40 percent canopy cover and the 30" dbh limit. As described earlier, there is ample evidence that such standards allow significant degradation in owl nesting and foraging habitat.

The owl biologists have consistently expressed serious concerns about fully implementing the QLG project. See, for example, Blakesley and Noon 1999 (expressing "particular concern" about planned logging within QLG pilot project area); Verner 2003, p. 6 (implementation of QLG project "will lower the viability of the owl population in affected national forests); Blakesley and Noon 2003, p. 5 (full implementation of QLG project deemed "inexplicable" and "unacceptable"); Peery 1999, 2004. To the best of our knowledge, no owl biologist has expressed support for fully implementing the QLG project. Moreover, both the Science Consistency Review and the

[7] To the contrary, the oft-quoted conclusion that the pilot project would result in a 7 percent decline in nesting habitat and an 8.5 percent decline in suitable habitat is based only on DFPZs and area treatments and fails to account for group selection or individual selection logging. Including group and individual selection in the analysis "could result in an additional 2 to 4% of suitable habitat potentially impacted" by the pilot project. (USDA Forest Service 1999a, p. 67). Thus, the quoted figures appear to be underestimates, rather than overestimates.

Washington Office review cited the plan's full implementation of the QLG project as an important factor in their determinations that the new plan would increase the risk to the owl's population. (Gladen 2003, pp. 10-11; Stine and Keane 2003, p. 9).

In sum, there is substantial evidence indicating that full implementation of the QLG project would threaten the viability of the California spotted owl and other species, contributing to a trend towards federal listing.

8. The 2004 Framework fails to prohibit cumulative effects to California spotted owls or their habitat.

The 2004 Framework fails to include any specific regulations to monitor or limit the amount of habitat impacted within owl home ranges or across the landscape. Our analysis of projects planned between 1993-1998 revealed that the Forest Service regularly concludes that projects "may affect" the California spotted owl, but does not keep track of how many times they have concluded this for a particular owl territory or landscape area. This can lead to population and habitat fragmentation at a landscape scale. The need for cumulative effects monitoring, analysis, and regulation is strongly supported by Noon and Blakesley (1999), who stated:

> "Harvest guidelines address factors of owl habitat at the local scale. However, rates of population change are affected by processes operative at both local and landscape scales. Therefore, it is important that harvest activities be evaluated collectively in order to assess their cumulative effects on habitat quality. Future management activities, for example, should not increase the mean nearest-neighbor distance among suitable owl pair sites. Management activities which reduce population density by lowering habitat quality or increasing habitat fragmentation will increase the uncertainties associated with successful dispersal and mate finding."

Because the 2004 Framework fails to monitor or regulate cumulative effects, they are inadequate to protect the owl or its habitat from continued habitat fragmentation, necessitating the owl's listing under the ESA.

9. The 2004 Framework fails to propose a strategy that reduces risk of stand-replacing fire in owl habitat, while minimizing risk of habitat loss from the very stand treatments designed to reduce fire intensity.

The Forest Service seeks to rationalize intensified logging pursuant to the 2004 ROD by arguing that an "aggressive" strategy is necessary to reduce the risk of catastrophic fire (2004 ROD, p. 3). However, the best available research does not support the Forest Service's contention that logging trees greater than 20" dbh or reducing canopy cover to 40 percent is necessary to reduce wildfire risk. Rather, research indicates that prescribed fire and other treatments that focus on reducing small diameter fuels are the most effective at reducing fire danger. The 2004 Framework, however, reduces the amount of prescribed burning. The Forest Service concedes that in old-forest emphasis areas the 2004 Framework will treat 212,754 less acres using prescribed burning, and 225,421 more acres using mechanical thinning than was prescribed under the 2001 Framework, even though science suggests this will be a less effective strategy (USDA 2004b). This shift will result in further loss of owl habitat without reducing fire danger.

It is generally recognized by fire scientists that fire resiliency largely is achieved by removing surface fuels and small diameter material. "Most of the trees that need to be removed to reduce accumulated fuels are small in diameter and have little or no commercial value" (U.S. General Accounting Office 1999, p. 44). "When thinning is used for restoration purposes in dry forest types, removal of small diameter

material is most likely to have a net remedial effect. Brush, small trees, along with fine dead fuels lying on top of the forest floor, constitute the most rapidly ignited component of dry forest" (Christensen et al. 2002, p. 2). Thus, "surface fuels are the means by which crown fires are sustained.... Without heavy surface fuels, crown fires are almost always absent, regardless of canopy cover, size class distribution, or the height to live crown" (Rice 2003, p. 2). As acknowledged in the FSEIS (Volume 2, p. 106): "It is the smaller trees that are making Sierra Nevada forests overly dense and prone to destructive wildfire."

Recent studies of the effects of fuel treatments on fire behavior also support the conclusion that fuel reduction that focuses on ladder fuels and small diameter material is effective in reducing catastrophic fire. Stephens (1998) examined a number of fuel treatments and used the model FARSITE to evaluate their efficacy. In all cases, the most successful fuel treatments included prescribed fire. Further, prescribed fire alone was as effective in reducing fire risk as treatments with logging and prescribed fire combined. "These treatments resulted in fuel structures that will not produce extreme fire behavior at 95th percentile conditions" (Ibid., p. 32). Further, the vegetative conditions in the watershed where the fire effects were modeled included canopy cover conditions of up to 100 percent cover. The prescribed burning treatments did not reduce in any way the canopy cover of the dominant and co-dominant trees, yet these treatments were as effective as the thinning/biomass/prescribed burn treatments in which canopy cover was reduced to 50 percent in some areas of the watershed. Thus, no change in canopy cover of the dominant and co-dominant trees was necessary to meet the fuel objective under extreme weather conditions. Furthermore, reducing canopy in some areas to 50 percent did not result in any additional benefit.

A recent study by Perry et al. (2004) found that simply reducing surface fuels by 50 percent, without any thinning, "is sufficient to prevent torching (fire moving from ground to crowns) on 13 of 14 plots in the ponderosa pine zone, even in high winds" (Perry et al. 2004, p. 924). A light thinning (removing trees less than 8" dbh), in combination with removing surface fuels, was sufficient to prevent torching in the fourteenth plot. Similar results were reported by van Wagtendonk (1996), who again emphasized that removal of the surface and ladder fuels is effective in changing fire behavior. These studies demonstrate that it is not necessary to remove medium to large diameter trees or alter canopy cover in order to prevent crown fire and other extreme fire behaviors.

Observations of wildfire behavior at Black's Mountain Experimental Forest in the Sierra Nevada also support the conclusion that removing surface fuels, not medium or large trees, is the critical factor in reducing risk of crown fire. In testimony before the Resources Subcommittee on Forests and Forest Health (House Resources Committee on Natural Resources, U.S. House of Representatives), UC Berkeley fire ecologist Dr. Scott Stephens reported the following:

> "When the wildfire entered the high diversity unit that had also been prescribe burned, it transitioned from a high severity crown fire to a very low intensity surface fire in about 200 feet. The treated forest almost stopped the wildfire in this unit. In the low diversity unit that had been prescribed burned a similar change in fire behavior occurred, from a severe crown fire to a low intensity surface fire in less than 200 feet. When the wildfire moved into the low diversity unit that had not been prescribe burned, the wildfire changed from a severe crown fire to a severe surface fire. The severe surface fire burned the majority of the unit and this killed approximately 60-80 percent of the trees. The wildfire burned in this unit because the activity and natural fuels were sufficient to carry the wildfire. If this treatment had also left the sub-merchantable trees on the ground as activity fuels, I am sure the whole unit would have

> experienced almost complete mortality. This occurred even though canopy cover, crown bulk density, and ladder fuels were very low in the low diversity units. Trees were widely spaced by the low diversity treatment and no crowns were overlapping. It simply provides more support that the target of almost all fuel treatments in mixed conifer, ponderosa pine, and Jeffrey pine forests must be the surface fuels. (Stephens 2004, p. 4, emphasis added)."

Dr. Stephens also concluded that with respect to the revision of the Framework:

> "Removal of moderately sized trees (20- 30 inches in diameter) can produce revenue and wood products for California, but in the majority of cases, it will not significantly reduce potential fire behavior. Removal of trees of this size will only reduce canopy bulk density and this will have a small effect on potential fire behavior in most forest stands. The target of fuels projects must be the surface and ladder fuels (Ibid., p. 4, emphasis added)."

Fire specialists participating in the Forest Service's Science Consistency Review of the 2004 ROD made similar conclusions:

> "The lowest priority is to treat the overstory trees (CROWN fuels). Generally, the larger trees are more resistant to fire damage than are smaller trees, regardless of species. Additionally, from a FIRE HAZARD perspective, if surface and ladder fuels are adequately treated, there is often little need to treat large, overstory trees (e.g., Megram Fire) because independent crown fires are very rare in California type forests (Dr. Carl Skinner, PSW fire scientist in Guldin and Stine 2003, p. 8)."

> "Only under the very most unusual circumstances will a fire move through the crowns without a surface fire to keep it going. Remove the surface fuels AND the ladder fuels (i.e., the standing live trees up to 6 inches in diameter). Treat the surface and ladder fuels, and you have reduced the risk of an active crown fire to an insubstantial level (Dr. Jan van Wagtendonk, fire scientist with the National Park Service in Guldin and Stine 2003, p. 8)."

> "Active crown fires are created when the surface and crown fires are linked as one structure. It is very rare to have independent crown fires in the Sierra, crown fires are almost always linked to high intensity surface fires. Without the high intensity surface fire the fire will drop from the tree crowns (Dr. Scott Stephens, UC Berkeley fire scientist, in Guldin and Stine 2003, p. 8)."

Thus, the overwhelming evidence provided by recent studies and observations from fire experts who work in the Sierra Nevada is that reducing surface and ladder fuels, rather than logging of medium-large trees and reducing canopy cover, is the most effective means to reduce the risk of crown fire in mixed conifer, ponderosa pine, and Jeffrey pine forests in the Sierra Nevada.

Fire scientists have also clearly addressed the negative effects on fire behavior that can result from the reduction of canopy cover. "Thinning or otherwise opening a stand allows more solar radiation and wind to reach the forest floor. The net effect, at least during periods of significant fire danger, is usually reduced fuel moisture and increased flammability (Countryman 1955). The greater the stand opening, the more pronounced the change in microclimate is likely to be" (Weatherspoon 1996, p. 1173). Weatherspoon and Skinner (1995) observed that uncut stands, with no treatment of natural fuels, burned less intensely than partial-cut stands with no fuel treatment or partial-cut stands with fuel treatments. They determined that the partial cuttings created a warmer, drier microclimate compared with that of the uncut stands and that fuel treatments of surface fuels might have been only partially effective. Even where thinning logging occurs in combination with fuels

treatments, the warming and drying of the stand has potential to offset the reduced fuel loading (Stephens 2003, p. 3). Thus, the "removal of more mature trees can increase fire intensity and severity, either immediately post-logging or after some years" (Christensen et al. 2002, p. 2).

Other analyses completed by the Forest Service confirm this as well. The environmental assessment for the Borda Project (Tahoe National Forest 2003) compares the fire behavior of two alternatives proposed to treat mixed-conifer and eastside pine stands. The analysis concludes that there is essentially no increased benefit to fire resiliency from cutting trees over 20 inches in diameter or by reducing canopy closure to 40 percent. The results of the Middle Fork Cosumnes analysis completed by the Review Team also demonstrated that significant reductions in the severity of the effects of wildfire resulted from applying the Framework standards. Even though approximately 93 percent of this landscape was limited to treatments that removed trees 12 inches in diameter or less (USDA Forest Service 2003, p. 26), lethal and mixed lethal fire in the analysis area was reduced by over 50 percent (Ibid., p. 29). A second landscape analysis completed for the Middle Fork Cosumnes area found that treatments that complied with the Framework reduced fire size, reduced the number of acres severely burned, and reduced flame lengths when post-treatment fire was modeled in the analysis (Eldorado National Forest 2002).

Carol Rice, a fire specialist, reviewed the fuels goals and objectives in the 2004 ROD and concluded that the goals "can be achieved through reduction of surface fuels, ladder fuels, and through thinning of trees that have a diameter less than 20 inches" (Rice 2004, p. 1). Allowing the removal of trees greater than 20 inches in diameter is not necessary to achieve the standards in the ROD (Ibid.)

In sum, the revisions to the Framework ROD allegedly were proposed in order to "allow more flexibility to strategically locate fuel treatments to and implement effective fuel treatments" (ROD, p. 8). Feedback from District Rangers and modeling efforts at a watershed scale were cited by the Forest Service as justifying the need for change. However, as admitted by the Forest Service, they never actually implemented the Framework ROD and watershed analysis actually demonstrated that the Framework ROD would reduce the number of acres burned and the intensity of the area burned. Thus, the Forest Service has failed to demonstrate that the Framework cannot be implemented. Beyond that, claims that the treatments allowed in the Framework ROD would not be effective in substantially reducing the risk of stand destroying fire are not supported by current knowledge of fire behavior in the Sierra Nevada. Fire experts familiar with Sierra Nevada systems unequivocally state that treatment of the surface and ladder fuels is sufficient to reduce the fire risk. Lastly, fire experts and the fire literature demonstrate that the removal of trees that are 20 to 30 inches in diameter and reduction of canopy cover to 40 percent are not required to achieve the desired fire resiliency in Sierra Nevada forests.

10. Conclusion.

In conclusion, the 2004 ROD will have a significant, adverse impact on spotted owl habitat in the Sierra Nevada at multiple spatial levels. See, for example, DSEIS, p. 184 (Alternative S2 would allow substantially more logging of PACs), p. 186 (Alternative S2 "could result in the removal of habitat attributes that provide quality nesting and foraging habitat"), p. 187 ("Alternative S2 would reduce the amount of multi-story canopy, stand complexity and canopy closure which could affect owl reproductive output"), p. 188 (Alternative S2 would result "in reduced owl densities and reduction in distribution of owls and owl habitat" in geographic areas of concern, as well as "increased fragmentation" in these areas). Overall, the Forest Service concludes that Alternative S2 is "likely to isolate subpopulations and limit the opportunity for interactions across NFS lands." (DSEIS, p.

193). The owl scientists have uniformly concluded that the plan would threaten the owl's distribution and viability, contrary to the agency's legal duty to ensure viability and avoid contributing to a trend towards federal listing under the Endangered Species Act. (Noon 2004; Verner 2003; Blakesley and Noon 2003; Peery 2004; Bond 2003).

B. Private Lands

1. Regulation of logging on private land is inadequate to protect the owl or its habitat

Because private lands compose a significant portion of the California spotted owl's range, the management of private lands is critical to the availability of habitat for the California spotted owl. Approximately 2.4 million acres, or roughly 40%, of potential spotted owl habitat occurs on land in private ownership in the Sierra Nevada (Verner et al. 1992). Of this amount, 1.45 million acres is owned by industrial private timber companies. Unfortunately, protection of habitat for the California spotted owl on these lands is nearly nonexistent.

In several locations, management of private lands has been found critical to maintaining continuity of the spotted owl population. For example, Beck and Gould (1992) identified four Areas of Concern for the long term viability of the California spotted owl based on significant private land holdings. Thus, private lands have an important role to play in maintaining the long-term viability of the California spotted owl.

In spite of the important role that private lands play in providing habitat for California spotted owl, the primary body of regulation affecting management of this species on private lands, the California Forest Practices Rules, allow significant alteration of spotted owl habitat and do not provide protection to critical features of spotted owl habitat, such as large trees, snags and downed wood, high canopy closure, and multi-layered canopies. This has resulted and continues to result in degradation and destruction of late successional habitat utilized by the California spotted owl. Beardsley et al. (1999), for example, conclude:

> "Any increase in old growth area in the Sierra Nevada ecosystem, would have to come mostly from the unreserved areas of the national forests, because these forests contain most of the forests having a mean diameter greater than 21 inches (59,000 acres of that was already old growth). Most of the area in private ownership is expected to be managed for non-old growth values."

Lack of forests with late successional characteristics on private lands is not surprising given that the applicable rules require maximizing timber production utilizing intensive logging methods, and fail to provide any effective protection for spotted owl habitat.

The following section first discusses the lack of protection local regulation provides for habitat of the California spotted owl. Second, the section addresses the intensive logging practices emphasized and encouraged by the California Forest Practice Rules (hereinafter referred to as "the Rules"), and the potential these practices have to degrade and destroy critical attributes of California spotted owl habitat. Finally, we address the failure of the Rules to provide any meaningful protection for spotted owls or their habitat, or any measures that would result in limiting or even mitigating impacts to California spotted owls or their habitat. Throughout this section we use information gathered from our review of planning documents from 416 timber harvests located within 2 miles of selected owl sites as a means to illustrate specific points. A full description of this analysis is presented elsewhere in this document.

In sum, the Rules offer almost no protection to the key characteristics of spotted owl habitat, and encourage logging practices that result in degradation and destruction of spotted owl habitat. As demonstrated by the lack of late successional forest on private lands (Beardsley

et al. 1999), these practices are likely to deplete private lands of habitat needed to maintain the viability of the California spotted owl, particularly in the "Areas of Concern" where private lands predominate. Regardless of the regulation governing public lands across the owl's range, the degradation and destruction of private land habitat may result in extirpation of the California spotted owl from large portions of its range.

a. State Regulation Fails to Provide Adequate Protection of California Spotted Owl Habitat.

Regulation governing private timberland encourages the maximization of timber production using intensive logging methods, and lacks any substantial protection for the California spotted owl and its habitat. The Rules (14 CCR Ch. 4 and 4.5) form the primary body of regulation that impact private industrial forest land within the range of the California spotted owl (Menning et al. 1997). The rules are administered by the California Department of Forestry and Fire Protection, and are the regulations implementing the Z'berg Nejedley Forest Practices Act of 1973 (4 Pub. Res. Code Ch. 8).

These rules require timber operators to produce a Timber Harvest Plan (THP) that is intended to serve as a substitute for the planning and environmental protection requirements of the California Environmental Quality Act of 1970 (Pub. Res. Code sections 21000-21177). The Rules provide for timber harvest practices and site preparation practices to be utilized. These regulations are implemented largely by preparation of THPs, which are essentially comprised of a lengthy checklist and supporting documentation, or in the case of the majority of the plans exempted from the THP process, by 1-2 page applications.

Few or none of the logging prescriptions described in the Rules would result in retention of spotted owl habitat features critical to the maintenance of owl populations on private land. As previously discussed, logging practices near owl sites appear to be extensive, sometimes affecting each acre an average of six times over the past eight years. Further, the Rules fail to provide any measures that provide explicit protection for the California spotted owl, and provide no effective measures to protect owl habitat in any meaningful quantity. Finally, the Rules fail to provide a mechanism for identifying individual or cumulative impacts to owls or owl habitat on private lands. The net result is that the Rules do not regulate logging on private lands in a manner that is adequate to maintain owl habitat or populations on private land within the range of the California spotted owl.

b. Logging under the Forest Practices Rules (FPR) results in degradation and destruction of critical features of habitat for the California spotted owl.

Harvest prescriptions allowed when preparing a THP. Because the logging practices named in the Rules are focused on the use of methods to achieve maximum timber production, extensive depletion of owl habitat has occurred and will continue to occur.

For all timber harvest prescriptions under the rules that apply to the normal THP process, silvicultural objectives are defined as follows: "[t]he RPF [registered professional forester] shall select systems and alternatives which achieve *maximum sustained production of high quality timber products*." (Forest Practice Rules, 14 CCR Ch. 4 section 913) (emphasis added). The Rules favor regeneration methods for achieving this objective (FPR, 14 CCR Ch. 4 section 913 (a)). Regeneration methods "are designed to replace a harvestable stand with well spaced growing trees of commercial species. Even age management systems shall be applied…" (FPR, 14 CCR Ch. 4 section 913.1).

This objective of "maximum sustained production" of timber is in direct conflict with the retention of the characteristics that comprise high quality spotted owl habitat. For example, this objective and the regeneration methods

described depend on the removal of large trees to provide high quality timber, which in turn leads to the removal of nest, forage and roost sites of the California spotted owl. Regeneration methods have resulted in the removal of key components of spotted owl habitat, such as large, old trees, multilayered canopies, snags, and downed logs (Bias and Gutiérrez 1992, Gutiérrez et al. 1992, LaHaye et al. 1997, Moen and Gutiérrez 1997) over the majority of private lands in the Sierra Nevada. Indeed, this is the clear intent of the Guidelines by stating that harvest should be designed to create "a harvestable stand with well spaced growing trees of commercial species." Specific regeneration methods recommended in the Rules include clearcutting, in which all of the stand is removed at one time (used in 51 of the 416 cases we reviewed); seed tree regeneration, in which most all of the stand is removed, and then the few remaining "seed trees" are removed in a second step (20 cases); shelterwood regeneration, in which a stand is removed in three steps (39 cases); transition (21 cases); and selection and group selection logging (82 cases). Many THPs proposed more than one of these harvest prescriptions. These regeneration methods entail complete removal of forest canopy and large trees, and as is clear by their definitions, would result in elimination of spotted owl habitat. In addition, regeneration methods result in significant reductions in canopy closure. This has the potential to severely degrade and/or destroy California spotted owl habitat by reducing canopy closure to less than that selected by spotted owls, and by eliminating the multi-layered canopies that characterize spotted owl habitat. In addition, the goal of maximum timber production and the various harvest methods are likely to result in removal of merchantable snags and or potential snag recruitment trees.

The Rules also recommend some uneven age regeneration prescriptions, including transition, selection, and group selection logging (FPR, 14 CCR Ch. 4 section 913.1, 913.2). The uneven age methods involve removal of individual or groups of trees. Though occurring over several entries, these methods on private lands are likely to result in removal of habitat characteristics required by the California spotted owl—large, old trees, snags, and dense, multilayered canopies. Verner, et al (1992) found that traditional selection logging has resulted in depletion of the large, old trees utilized by spotted owls, and found that on public lands "[e]ven on lands planned for selection harvest, we have no guarantee that harvest prescriptions will leave any of the large, old trees." (Verner et. al 1992). There is no reason to assume that selection logging would be more likely to result in maintenance of owl habitat than re-generation logging.

Lastly, the Rules define several "intermediate treatments." (FPR, 14 CCR Ch. 4 section 913.3) These treatments include both commercial thinning and sanitation-salvage logging. Under the Rules, commercial thinning is defined as follows:

> "Commercial thinning is the removal of trees in a young-growth stand to maintain or increase average stand diameter of the residual crop trees, promote timber growth, and improve forest health. The residual stand shall consist primarily of healthy and vigorous dominant and codominant trees from the preharvest stand (FPR § 913.3)."

This treatment is designed to maintain young, evenly spaced stands of healthy, straight trees as described above. Generally, such stands, sometimes referred to as plantations, lack most or all of the stand components required by the owl. From the review of owl sites that we conducted, it does not appear that commercial thinning is a dominant logging prescription near owl sites. Of the 416 owl sites, only 28 utilized commercial thinning methods.

The sanitation/salvage method is one of the most commonly utilized prescription under exemptions to the THP process (see below) and is defined in the Rules as removal of trees that

are "insect attacked or diseased trees…[or, for sanitation logging] trees…that are dead, dying, or deteriorating" because of damage from a variety of causes (FPR, 14 CCR Ch. 4 section 913.3 (b)). The Rules provide little criteria for defining what constitutes a "dying or diseased" tree. Further, the rules state that "the RPF shall estimate the expected level of stocking to be retained (see Forest Practice Rules, 14 CCR Ch. 4 section 913.3 (b))," rather than prescribing stocking levels specific to the prescription. Thus, it is clear that this prescription could result in removal of numerous large trees, significant reduction in canopy closure, and removal of all merchantable snags or potential snag recruitment trees. This logging method was used in 18 of the 416 cases we reviewed in which a THP was completed.

In addition to intermediate and regeneration methods, there is an additional but ill-defined catch-all prescription used in a number of cases we reviewed— "alternative," used in 32 of the 416 cases. These prescriptions appear to allow the destruction of key habitat components, as do the regeneration prescriptions described above.

In sum, it is apparent that the regeneration methods and intermediate harvest methods utilized are likely to be extremely destructive to critical characteristics of spotted owl habitat, including large trees and multilayered forest canopy. The methods recommended would result in total elimination of the forest characteristics associated with California spotted owl habitat. Without effective restrictions, logging conducted under these rules has destroyed and will continue to destroy and degrade spotted owl habitat over a large portion of its range.

c. Timber harvest operations exempt from THP stocking and analysis requirements are also likely to pose significant threats to habitat for the California spotted owl.

The Rules exempt a number of logging operations from the Timber Harvest Planning process. Approximately 69% of the timber harvest documents we reviewed, or 287 of 416, fell into this category. Specific exemptions from the THP process include "harvesting of dead, dying, or diseased trees of any size" (utilized in approximately 175 cases we reviewed), logging of 3 or less acres (25 cases), "other" (57 cases), and a number of other lesser used exemptions (FPR, 14 CCR Ch. 4 section 1038).

The various exemptions from the THP process and requirements include a number of specific restrictions. The exemption for harvest of "dead, dying, or diseased trees" was utilized most often in the cases we reviewed. This exemption allows logging of no more than 10% of the average volume on each acre. In addition, a number of specific restrictions of potential impacts are built in to the exemption. For example, new road construction is prohibited. However, there are no specific restrictions on impact to spotted owl nest sites or habitat. For example, there are no restrictions on the size of trees removed. In addition, the exemption guidelines fail to limit the frequency in which an exemption can be used for the same area. In numerous cases, our review of timber planning documents indicated that exemptions had been submitted each year for as many as 7 years on the same area. In most cases, the areas with repeated exemptions exceeded 20,000 acres in size. Under this exemption, private landowners can enter stands as often as an exemption is filed (often yearly) and remove up to 10 percent per acre of volume, eventually removing all attributes of suitable owl habitat.

In sum, the dead, dying and diseased exemption results in the degradation of important characteristics of spotted owl habitat. A CDF forester estimated that only about 10% of exempted plans are subject to any review by the CDF, and stated that plans filed under this exemption are considered a "non-discretionary" document, which the CDF is obliged to approve (pers. comm. with Dave Macnamara).

Finally, "emergency management" of timber is also exempted from the requirements of the

THP process. This exemption applies to stands that have been substantially damaged by fire or other natural causes. This exemption was used in 33 of the cases we reviewed. Because the Rules fail to define what constitutes a "substantially damaged stand," this exemption could be used in any number of situations that hardly constitute an emergency. For example, it could be used to clearcut a stand where a fire had burned, but left most of the trees alive.

Given the large number of acres and timber harvests occurring under these exemptions, on land that is very near owl sites, this lack of protection raises serious concerns about the effects of timber harvest on owl habitat. Coupled with the degradation and destruction of owl habitat that is occurring under the THP process, current regulation of logging on private lands is clearly not adequate to protect the California spotted owl from becoming endangered with extinction.

d. Protections provided to species of special concern by CEQA are inadequate to protect the California spotted owl on private lands.

Potential protections provided by CEQA were recently summarized by the Fish and Wildlife Service in its decision to not list the California spotted owl. The owl finding correctly states that:

> "CEQA requires a full disclosure of the potential environmental impacts of public or private projects carried out or authorized by nonfederal agencies within the state of California… Section 15065 of the CEQA Guidelines, as amended, requires a finding of significance if ``[t]he project has the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish and wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare or threatened species' (CEQA 2001b)."

The finding also correctly states that this requires review of effects for species of special concern at the discretion of CDFG personnel, who could "determine that, although not listed" the owl "is a de facto endangered, threatened, or rare species under section 15380 of CEQA." The finding, however, was incorrect in stating that:

> "The CDFG has identified the California spotted owl as a Species of Special Concern (CDFG 1978). This status applies to animals not listed under the Federal or the California Endangered Species Act but which appear to be vulnerable to extinction. The intent of this designation is to obtain special consideration for these species in the project planning process and to focus attention on the species to avert the need for listing under either State or Federal laws. CEQA requires that impacts to such species be mitigated. Although state and local agencies have discretion to approve projects that impact a Species of Special Concern, such impacts must be mitigated."

CEQA does not require that impacts *must* be mitigated. Rather it requires that if significant effects are found, mitigation must be adopted *where feasible*, and if determined to be infeasible, an explanation must be provided. The finding correctly notes that this rarely occurs, stating:

> "Once significant effects are identified, the lead agency has the option of requiring mitigation for effects through changes in the project or to decide that overriding considerations make mitigation infeasible (Sec. 21002) (CEQA 1996a), although such an override requires justification and is rarely implemented."

Fish and Wildlife is correct that overrides are rarely implemented. This is not, however, because of the routine application of mitigation. As a matter of routine, projects are found not to have significant effects and mitigation is almost

never required. Indeed, we challenge Fish and Wildlife to produce one CEQA document that has required mitigation for the owl (beyond the nest stand requirements required by the FPR).

That mitigation is never required and projects routinely make determinations of no effect does not reflect the fact that projects are not impacting owl or other species habitat. Rather, the standard for considering effects is high. This is reflected in the CEQA language which defines significant effects as having to:

> "substantially reduce the habitat of a fish and wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of an endangered, rare or threatened species"

Only in the rare cases that a species is on the brink of extinction and occurs in a very limited geographic area, will an individual project cause sufficient damage to rise to the above definition.

In relation to logging projects, CEQA requirements are met through preparation of THPs. As noted in the finding, "the FPRs require a cumulative effects assessment to address any significant known wildlife or fisheries concerns where there is a substantial reduction in required habitat or the project will result in significant interference with the movement of resident or migratory species." This requirement could lead to a conclusion that multiple projects lead to significant effects. However, the owl finding also correctly notes that: "less than 25 percent of THPs are field checked by the CDFG, and most THPs do not adequately assess cumulative impacts (Berbach pers. comm. 2002)."

As expected, our review of 416 timber harvest documents that impacted 18 owl sites revealed extensive impacts to land within 2 miles and 0.5 miles of the owl sites we reviewed, and almost no mention, analysis, or mitigation of these impacts in the associated timber harvest documents. Very few of the timber harvest documents mentioned the spotted owl at all, even when impacts were to occur within 0.5 mile of an owl site. Of the 416 timber harvest plans that occurred within a 2 mile radius of the 18 owl sites we examined, only 81 mentioned the California spotted owl and of the 116 timber harvest operations within 0.5 mile of a known owl site, only 21 mentioned the California spotted owl. Of the timber harvest documents that did mention the spotted owl, less than half identified spotted owls within the timber harvest area or made other reference to impacts expected to result from the timber harvest plans; only ten discussed impacts to or characteristics of spotted owl habitat occurring in the project area; and one named mitigation measures designed to avoid impacts to an identified owl. Significantly, 48 of the 81 documents where the owl was mentioned disavowed the presence of spotted owls, either by stating that known spotted owls were located on adjacent Forest Service land, that no spotted owls were found within the THP area, or that the area provided no owl habitat. These oblique references contained mostly generality and no real analysis of possible effects. For example, one such statement erroneously described Forest Service management of owl habitat as follows: "[t]he USFS has designated most of their land as SOHA or PACs."

In sum, CEQA requires analysis and mitigation where feasible for projects that are determined to have a significant effect on the environment, including wildlife populations. This has the potential to result in analysis and mitigation of effects to the owl from timber sales and other projects, particularly if proper cumulative impacts assessments were performed. As a matter of practice, however, projects are routinely found to not have significant effects on the owl or other species and thus mitigation is rarely required or implemented.

e. Requirements for protection of active nest sites provide little short term and no long term protection to California spotted owl nest sites.

Under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. section 703 et. seq.), the take of a migratory bird or its nest is prohibited (16 U.S.C. section 703). The spotted owl is listed as a migratory bird (50 CFR 10.13), and thus is entitled to protection under the MBTA. Such protection would include the protection of nest trees from removal during timber harvest. However, the Rules fail to require survey for or identification of nest sites for non-sensitive species, including the spotted owl (FPR § 919.2). Similarly, the Rules fail to provide nest buffers where cutting is prohibited for the spotted owl, as is provided for a number of sensitive species (FPR § 919.3). Thus, even if a nest were by some accident identified, under current regulations only the nest tree and not the surrounding stand would be protected under either the MTBA or the Rules. Such protection would not result in maintenance of nest sites. However, even this minute level of protection is rarely applied. Our review of 416 timber harvest operations within 2 miles of known owl sites, 116 of which were within 0.5 mile of an owl site, found that only 1 timber harvest document provided protection for a nest tree. In addition, neither the Rules or the MBTA require protection of potential nest sites that are not currently active, even if nest sites have recently been active and may be active in the future.

f. The Rules' requirement for assessment of impacts to late successional forests and for mitigation of impacts do not appear to result in any significant protection of habitat for the California spotted owl.

The Rules require very limited assessment of impacts to and almost no protection for late succession forest stands within THP areas (FPR §919.16, 939.16, 959.16). The Rules require that "when late succession stands are proposed for harvesting and such harvest will significantly reduce the amount and distribution of late succession forest stands," then information about these stands must be included within the THP (FPR, §919.16.). In practice, this provision is almost never invoked. Of the 416 timber harvests near owl sites that we reviewed, late successional forests were mentioned in only 7 cases. Out of the 2,366,753 acres of private land impacted by these 416 timber harvests, at least part of which occurred within the 18 owl sites assessed, only 728 acres of late succession forest habitat were identified.

The failure of timber harvest documents to identify impacts to spotted owl habitat with late successional forest characteristics appears to be due to several factors. First, by definition under the FPA, late successional forest stands less than 20 acres in size are not recognized. Conclusions from Beardsley et al. (1999) suggest that large diameter trees that would be needed to satisfy the definition of CWHR classification 5M, 5D, and 6 are in extremely low densities on private lands. Thus, the few scattered large trees that may exist on private lands are unlikely to be in sufficient densities within stands exceeding 20 acres to merit identification as late-successional forest. It is likely that the last remnants of late-successional forests on private lands lack protection because they cover too small an area. Second, no analysis of late-successional forest is required unless the timber harvest plan itself would result in a significant reduction of habitat. There is no provision requiring analysis of the cumulative effects of removal of late-seral forest habitat, nor is there discussion of what might constitute a significant reduction in late succession forest habitat. Thus, it is possible for a cumulatively significant reduction of late successional forest to occur because the THP process allows incremental steps in this loss to be ignored.

Even if invoked, however, this provision requires analysis and mitigation of impacts only when feasible (FPR §919..16 (a), (b).). No firm protection of old forest characteristics or acres of habitat is required. As a case in point, of the seven timber harvest documents that mentioned

late-successional forests, none included specific mitigation measures that would reduce impacts.

In sum, the late succession forest provision provides little protection to older forests even if invoked, and is invoked in practice in so few cases that it appears unlikely that this provision is providing meaningful protection for even a small percentage of California spotted owl habitat.

g. The Rules requirement for retention of snags provides little or no protection to this feature of owl habitat.

Though snags are an important component of spotted owl habitat, the Rules list numerous conditions under which snags may be removed and fail to require that a minimum number of snags be retained. Further, the Rules suggest removal of large (FPR §919.1 (d)) snags near roads and ridgetops (FPR §919.1 (a)(1), (a)(2)). Of the 416 timber harvest documents we reviewed, only five discussed retaining snags. Of these, three documents indicated retaining only snags that were visibly used by wildlife, one indicated that non-merchantable snags would be retained, and one indicated that all merchantable and non-merchantable snags would be retained. Eighty-two of the 416 timber harvest documents stated that snags would be removed near roads, skid trails, and landings, or more broadly. Reasons given for removal of snags included "hazard," fire danger, and a statement that merchantable snags would be removed. It was not clear that snags would be retained in the remaining cases.

In sum, the Rules provide for no minimum number of snags to be retained and encourage removal of snags to such a degree that it is extremely unlikely that snags would be retained at levels needed to maintain suitable habitat for the owl. In practice, few timber harvest documents appear to require retention of snags.

h. The Forest Practices Rules fail to prohibit individual and cumulative impacts to owls and their habitat.

As detailed above, the Rules fail to provide any meaningful protection to spotted owls or their habitat. These flaws on their own render the Forest Practices Rules inadequate to maintenance of owl populations and habitat on private lands. Even if the Rules did provide meaningful protection for the owl, however, lack of funding and adequate mechanisms to identify impacts to spotted owls as currently practiced would render such hypothetical regulations ineffective. For example, while the THP process does require a "cumulative effects analysis," lacking identification of individual effects on owls due to funding or absence of analysis guidelines, no cumulative analysis is possible. Further, in the case studies we conducted, no analysis of cumulative effects of multiple timber operations on owl sites was performed, even in the very few cases where owls were identified in the project area.

Numerous independent commissions and academic research groups have reviewed the Forest Practices Rules and found them lacking (Wildlife Habitat/Forest Practice Task Force 1990, Wildlife/Science Committee 1994, Little Hoover Commission 1994, Menning et al. 1997). While critiques have been diverse and lengthy, some common themes include the lack of funding and personnel needed to conduct review of THPs; the lack of a mechanism for conducting analysis of cumulative effects on wildlife and other resources; and the lack of consistency in implementing the provisions of the Forest Practice Rules.

In the cases we reviewed, approximately 69% of the timber harvests were conducted under exemptions to the THP process (287 out of 416). These exemptions addressed timber harvest on 2.3 million acres during a 9 year period. The area covered by THPs was approximately 81,817 acres. Beyond this, a substantial proportion of the acres covered by a THP were also included under an exemption for

"harvest of dead, dying, and diseased trees" at some time during the 9 year period. Nonetheless, only 64 THPs reported that prior logging had occurred and none of these mentioned the removal of dead, dying, or diseased trees. Thus, cumulative effects analysis, in the very limited manner that are required under THPs, was completed on less than 4% of the acreage affected by timber harvest during the past 9 years. And in no case were cumulative effects on the owl or its habitat mitigated.

In conclusion, the Rules provide no meaningful protection for spotted owls or their habitat and no provisions for identifying impacts to spotted owls either from individual projects or cumulatively. Thus, even if there were protections, there would be no way of ensuring they were effective or being enforced.

i. SPI's "Option A Demonstration of Maximum Sustainable Production"

On January 1, 1999, SPI completed an "Option A Demonstration of Maximum Sustainable Production,"(MSP) which Fish and Wildlife relied on heavily in their decision to not list the California spotted owl. Based on a review of the Option A, we find that it is unlikely to protect owl habitat and that it doesn't meet the U.S. Fish and Wildlife Service's criteria for determining whether a conservation effort contributes to making listing of the owl unnecessary (FR: March 28, 2003 V. 68, No. 60).

SPI's Option A does not primarily address or prescribe protections for the owl or any other species of wildlife. Rather, it demonstrates that SPI will maintain "maximum sustained production" as required by the California Forest Practices Act (Section 14 CCR 933.11), which is defined in part as:

> "The projected inventory resulting from harvesting over time shall be capable of sustaining the average annual projected yield achieved during the last decade of the planning horizon. The average annual projected yield over any rolling 10-year period, or over appropriately longer time periods for ownerships, which project harvesting at intervals less frequently than once every ten years, shall not exceed the projected long-term sustained yield."

The purpose of the Option A is thus to demonstrate that harvest is not exceeding a maximum sustained amount. This is not exclusive of protection of wildlife as the statute does state that landowners take into account: "limits on productivity due to constraints imposed from consideration of other forest values, including but not limited to recreation, watershed, wildlife, range and forage, fisheries, regional economic vitality, employment and aesthetic enjoyment" (14 CCR 933.11(a)(1). These concerns, however, are not a primary focus of the statute and it does not prescribe any specific actions that must be taken to protect wildlife or other values. SPI proposes to obtain MSP using a combination of even-aged and uneven-aged management in stand rotations of 80 years.

SPI's demonstration of MSP provides little to no protection, failing to provide any specific protections for owl habitat. The only protection for wildlife that is provided is what is required under the Forest Practices Act, which is minimal protection for nest stands of Board of Forestry listed and state and federal listed species, such as the goshawk and northern spotted owl, which are very minimal and do not include the California spotted owl.

In addition to these highly limited protections, SPI claims that within 60-100 years their lands will transition from being predominantly early-seral and small tree to predominantly large tree forest and that this will benefit late-successional associated species, such as the owl. Essentially, they are arguing that all of their lands that currently don't have any marketable timber will be habitat in roughly 80 years, when they will begin cutting them again. This is problematic for the owl and other late-successional species

because it is unlikely that 80 years is sufficient time to develop quality habitat, and even if habitat did develop SPI would begin cutting it again using harvest methods that harm owl habitat.

Although not totally clear, SPI defines these large tree forests as having 60-100% canopy closure and an average diameter of over 24". Such forests have some but not all of the characteristics required by the owl. A number of studies discussed above found that California spotted owls selected stands for nesting and roosting that contained one or more very large (>40" dbh), old trees and that typically nest trees are very old (>200 years). Eighty year even-age rotations will not maintain these features on SPI lands. In support of this conclusion, Verner et al. (1992) concluded that:

> "In an even-aged system, these old-growth features can be created only by an extreme extension of the rotation interval. Even if the rotation interval is extended to 150 years, for instance, no trees will match the average age of the forest at the beginning of this century. Decadent features in stands are functions of age, not just d.b.h, and any animals that depend on decadent features (cavities, broken-tops, snags), or the large woody debris they create, will simply drop out of these forests"

Verner et al. add that "even on lands planned for selection harvest, we have no guarantee that harvest prescriptions will leave any of the large, old trees."

A number of studies have found that large trees, snags and logs are at historically low levels in the Sierra Nevada and in particular on private lands (Bias and Gutiérrez 1992, Franklin and Fites Kaufmann 1996, Beardsley et al. 1999). Bias and Gutiérrez (1992), for example, found that private lands in an area of checkerboard ownership within the Eldorado National Forest were generally depauperate of large trees and snags and other characteristics typical of late-successional forests. SPI's Option A fails to provide any protection for large trees, snags and downed logs or to ensure that such features will ever develop. Thus, even if SPI's models are accurate and they do produce greater area of large tree forest in 60-100 years, it is unlikely that such forests will provide trees, snags, and logs over 40" in diameter as selected by the owl.

Even if it did produce such forests, once they have developed SPI will begin cutting them again, displacing any owls that may occupy the habitat. This is because SPI is not providing any protection for owl nest stands or core areas. Rather, they are simply not cutting the areas that currently don't have any timber value anyway.

The U.S. Fish and Wildlife Service recently developed a policy for evaluating the contribution of conservation efforts towards negating the need for listing (FR: March 28, 2003 V. 68, No. 60). In the following discussion, we use criteria from this policy to evaluate SPI's Option A demonstration. We had a difficult time applying the criteria to SPI's demonstration because it is not actually designed to benefit the owl or any other species and most of the questions relate to conservation efforts directed at a species, leading us to the conclusion that Fish and Wildlife should not rely on the demonstration in its decision of whether to list the owl because it is not actually a conservation effort. However, Fish and Wildlife did rely on it in their decision to not list the California spotted owl, and thus we feel obliged to analyze it using the criteria they established for themselves to evaluate ongoing management.

The first set of criteria relate to the certainty that the conservation effort will be implemented, and include among other things whether the "staffing, funding level, funding source, and other resources necessary to implement the effort are identified," whether there is "a high level of certainty that the party(ies) to the agreement or plan that will implement the conservation effort will obtain the necessary funding, and whether "an implementation

schedule (including completion dates) for the conservation effort is provided."

As stated above, SPI is not proposing any conservation measures to benefit the owl, so we can't evaluate the likelihood that they have the authority, funding or specifics documented to implement them. What they are primarily proposing is to continue logging areas that currently have marketable timber and may contain habitat for the owl and to not log areas that are currently in an early-seral or young forest condition and to do this in a manner that will allow for sustained production of timber. According to their demonstration, they will cut timber using an 80 year rotation using both even-aged and uneven aged prescriptions. As discussed above, current information on the habitat needs of the owl indicate such harvests will not preserve habitat.

Even if the demonstration was going to produce owl habitat, however, there is no guarantee they will follow the demonstration. Under California's Forest Practices Rules, they must demonstrate that they are producing maximum sustained production. However, this does not mean they have to follow the Option A demonstration. According to the demonstration, SPI can deviate from the document as needed:

> "We monitor our inventory, growth and harvest activities over time, and will submit updates to this document as necessary. We will use the Option B – FPR section 1091.13 rule as guidance for determining whether updates are substantial or minor (any deviation from the average harvesting projections in any ten year period which exteeds ten percent shall be deemed substantial and would require modification or amendment to this document)."

In other words, the demonstration does not qualify as a regulation that should be evaluated as part of the adequacy of regulations to protect the owl because it is up to the discretion of SPI to follow it and can be modified at any time.

The second set of criteria developed by the U.S. Fish and Wildlife Service relate to the certainty that the conservation effort will be effective. The following discussion address these individually with the criteria in italics and our response below:

1. The nature and extent of threats being addressed by the conservation effort are described.

SPI's demonstration of MSP does not describe the nature or extent of any threats to the owl or any other species.

2. Explicit objectives for the conservation effort and dates for achieving them are stated.

SPI does not have any specific objectives for maintaining owl populations or habitat on their land. They do commit to using 80 year rotations in a manner that will sustain production of high quality timber, but as discussed above this is unlikely to maintain key features of owl habitat across the landscape.

3. The steps necessary to implement the conservation effort are identified.

No steps to ensuring the survival or recovery of owl populations on SPI lands through any conservation efforts are identified. All that is identified in an increase in the area of large tree habitat beginning in roughly 60 years and that timber will be cut in 80 year rotations using even-aged and uneven aged management.

4. Quantifiable, scientifically valid parameters that will demonstrate achievement of objectives, and standards for these parameters by which progress will be measured, are identified.

No objectives are established for the owl, including no objectives for habitat area or population size and thus progress cannot be measured. Given that the demonstration is not spatially explicit, does not set interim goals and does not specify the scale to which progress should be measured, it would be exceedingly

difficult even to determine whether they are meeting their goal of creating more large tree habitat. Under the MSP, they can clearcut entire watersheds in the next ten years, for example, removing all owl habitat, but still claim they will maintain MSP across their lands.

5. Provisions for monitoring and reporting progress on implementation (based on compliance with the implementation schedule) and effectiveness (based on evaluation of quantifiable parameters) of the conservation effort are provided.

The demonstration contains no provisions for monitoring owl populations or habitat. As noted above, SPI does monitor harvest and growth of timber in order to demonstrate MSP. However, they can deviate from MSP in any given area provided that all of their lands are in compliance because of the lack of spatial explicitness in the plan and they can deviate in any time period provided they amend the document and show they will meet MSP in the long-term. In sum, it would be very difficult to prove they are out of compliance in any one portion of the landscape or during any period of time. Rather, it will require waiting 60-80 years to determine if they have actually produced as much large tree habitat as they say.

There are no provisions for monitoring the effectiveness of the demonstration of MSP for benefiting owl or any other species.

6. Principles of adaptive management are incorporated.

No.

In summary, SPI's demonstration of MSP does not meet the criteria established by the U.S. Fish and Wildlife Service for determining that a conservation effort obviates the need for listing of the owl.

2. Regulations governing development on private lands

County Regulation of Private Lands in the Range of the California Spotted Owl. We reviewed the majority of county plans within the range of the California spotted owl and found that none contained provisions to protect the owl or its habitat from development. Further, because the California spotted owl is not a state listed species, there is no requirement under the California Environmental Quality Act (CEQA) that developers analyze the effects of their actions on the owl. In sum, even though extensive California spotted owl habitat occurs in foothill areas of the Sierra Nevada and southern California and many of these areas are available for development, there is currently no protection for the owl against development.

C. State lands

To date, 17 territories have been found on lands owned or managed by the State of California, 11 of which are considered reliably extant (Gould unpub. data). In the Sierra Nevada, there are 16,580 acres in state parks, 13,840 acres in two state forests and 3,320 acres held by the University of California (Beck and Gould 1992). In southern California, there are 58,482 acres in state parks. Recreation is the main threat to owls occurring in the state parks, but the severity of impacts probably varies between the individual parks based on use and management objectives. Logging occurs in the state forests and has substantially reduced suitable owl habitat. For example, only 960 acres of the 4,807 acre Mountain Home State Forest in Tulare County, remain in an old growth condition and only 2,000 acres of the 9,033 acre Latour State Forest have a significant large tree component (Beck and Gould 1992). Logging is continuing on both of these state forests. Protection afforded to California spotted owls on state lands by existing regulations is essentially the same as on private lands, meaning there is little to no specific regulations to protect the owl.

D. National Park Service

Four National Parks are located within the range of the California spotted owl, including Lassen Volcanic, Yosemite and Sequoia/Kings Canyon National Parks (NPs). In total, these parks contain 1,719,039 acres, of which approximately 460,687 acres may be suitable for nesting and foraging (Beck and Gould 1992). Surveys have located 130 territories, of which 57 are in Yosemite, 54 are in Sequoia, 12 are in Kings Canyon and 7 are in Lassen Volcanic (Gould unpub. data). Only 64 of the 130 are considered reliably extant, reflecting lack of recent surveys. The mission of the National Parks, which is in part to "maintain all the components and processes of naturally evolving park ecosystems," is generally in line with maintenance of suitable spotted owl habitat. However, recreation and development of park facilities could pose a threat to individual owls. The Park Service recognizes the spotted owl as a "special status species," but has not developed specific management guidelines to ensure protection of owls within Park boundaries.

E. Bureau of Land Management

BLM lands are scattered throughout the foothills of the Sierra Nevada and southern California ranges. Many of these lands support forest, woodland and riparian/hardwood stands that are potentially suitable for the California spotted owl. There are approximately 68,500 acres in the Sierra Nevada and 7,560 acres in southern California of potentially suitable habitat on BLM lands (Beck and Gould 1992). Forested BLM lands within the Sierra Nevada are managed partially for timber production, where uneven aged harvest is emphasized. Other BLM lands are managed primarily for livestock grazing. Seventeen owl territories, 14 of which are considered reliable, have been documented on BLM lands (Gould unpub. data). The owl has not been given any special management status on BLM lands, nor does the BLM routinely consider or mitigate the effects of its actions on the owl.

F. Tribal lands

Five owl territories have been located on Native American lands in the Sierra Nevada (1) and southern California (4) (Gould unpub. data). The amount of suitable habitat on these lands is unknown at this time. It is also unknown to what degree management of these lands is compatible with maintenance of suitable habitat.

G. Other regulations protecting California spotted owls on public or private lands.

Migratory Bird Treaty Act (MBTA). The MBTA (16 U.S.C. section 703 et. seq.) prohibits the take of a migratory bird or its nest (16 U.S.C. section 703) and the spotted owl is listed as a migratory bird (50 CFR 10.13). However, this only prohibits killing of the owl or cutting down an active nest tree. It does not provide broad-scale protection of habitat required by the owl.

National Environmental Protection Act (NEPA). NEPA requires Federal agencies, including the Forest Service, to consider the effects of their actions on the environment. It, however, does not prohibit them from choosing alternatives that will negatively effect individuals or populations of California spotted owls.

National Forest Management Act (NFMA). The California spotted owl is listed as a sensitive species by the Forest Service, but this affords it little protection. While the NFMA regulations at 36 C.F.R. §219.19 states that "Fish and Wildlife habitat shall be managed to maintain viable populations of existing native and desired nonnative vertebrate species in the planning area," it does not prohibit the Forest Service from carrying out actions that harm species or their habitat, stating only that "where appropriate, measures to mitigate adverse affects shall be prescribed" (36 C.F.R. §219.19(a)(1)).

IX. Critical Habitat

Petitioners request and strongly recommend the designation of critical habitat for the California spotted owl coincident with its listing. Critical habitat should be designated in all areas where the California spotted owl is currently located and in key unoccupied and unsurveyed areas where restoration is necessary for the conservation of the species.

X. Conclusion

The combination of well documented declines in all demography study areas with compelling evidence that these declines are at least partly the result of habitat loss, degradation and fragmentation, hundreds of "may affect" determinations by the Forest Service, and inadequacies in the 2004 Framework revisions and the State forest practices code all indicate that the California spotted owl incontrovertibly merits listing under the Endangered Species Act.

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References

Agee, J. K. 1993. Fire Ecology of Pacific Northwest Forests. (First ed.): Island Press.

Agee, J. K. 1996, January 16-18, 1996. The Influence of Forest Structure on Fire Behavior. Paper presented at the 17th Annual Forest Vegetation Management Conference, Redding California.

Allendorf, F.W., R.F. Leary, N.P. Hitt, K.L. Knudsen, L.L. Lundquist, and P. Spruell. In press. Intercrosses and the U.S. Endangered Species Act: including hybridized populations as westslope cutthroat trout. Conservation Biology.

American Ornithologist's Union. 1957. Check-list of North American birds. Baltimore, MD: Lord Baltimore Press.

Anderson, M. C., and D. Mahato. 1995. Demographic models and reserve designs for the California spotted owl. Ecological Applications, **5**(3), 639-647.

Bandier. 1892. Life Histories of North American Birds. .

Barrowclough, G. F., and R. J. Gutiérrez. 1990. Genetic variation and differentiation in the spotted owl. The Auk, **107**, 737-744.

Barrowclough, G. F., R. J. Gutiérrez, and J. G. Groth. 1999. Phylogeography of spotted owl (*Strix occidentalis*) populations based on mitochondrial DNA sequences: gene flow, genetic structure, and a novel biogeographic pattern. Evolution, **53**(3), 919-931.

Barrows, C. W. 1980. Feeding ecology of the spotted owl in California. Raptor Research, **14**(3), 73-78.

Barrows, C. W. 1981. Roost selection by spotted owls: an adaption to heat stress. The Condor, **83**, 302-309.

Barrows, C. W., P. H. Bloom, and C. T. Collins. 1982. Sexual differences in the tail barring of spotted owls. North American Bird Bander, **7**(4), 138-139.

Bart, A. J., M. Berg, J. H. Beuter, W. Elmore, J. Fay, R. J. Gutiérrez, H. T. Heintz, R. S. Holthausen, K. Starkey, and J. C. Tappenier. 1992. Recovery Plan for the northern spotted owl final draft . Washington, D.C.: Department of the Interior.

Beardsley, D., C. Bolsinger, and R. Warbington. 1999. Old growth forests in the Sierra Nevada: by type in 1945 and 1993 and ownership in 1993 (Research Paper PNW-RP-516). Portland, OR: USDA Forest Service Pacific Northwest Research Station.

Beck, T. W., and G. I. G. Jr. 1992. Background and the current management situation for the California spotted owl. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. PSW-GTR-133, pp. 37-54): USDA Forest Service, Pacific Southwest Research Station.

Beesley, D. 1996. Reconstructing the landscape: an environmental history, 1920-1960. In W. R. Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 3-24): University of California, Davis.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation, **54**(1), 419-431.

Bias, M. A., and R. J. Gutiérrez. 1992. Habitat associations of California spotted owls in the central Sierra Nevada. Journal of Wildlife Management, **56**(3), 584-595.

Bingham, B.B., and Noon, B.R. 1997. Mitigation of habitat "take": application to habitat conservation planning. Conservation Biology 11:127-139.

Blakesley, J. A., A. B. Franklin, and R. J. Gutiérrez. 1990. Sexual dimorphism in northern spotted owls from northwest California. Journal of Field Ornithology, **61**, 320-327.

Blakesley, J.A., B.R. Noon, and D.W.H. Shaw. 2001. Demography of the California spotted owl in northeastern California. Condor, 103(4), 667-677.

Blakesley, J.A. 2003. Ecology of the California spotted owl: breeding dispersal and associations with forest stand characteristics in northeastern California. Dissertation. Colorado State University, Fort Collins, CO.

Blakesley, J.A., and B.R. Noon. 2003. Letter to Phillip Detrich, U.S. Fish and Wildlife Service responding to a "demography synopsis for the California spotted owl 12-month finding," prepared by Darrin Thome. January 13, 2003.

Blakesley, J.A., B.R. Noon, D.R. Anderson. In press. Site occupancy, apparent survival and reproduction of California spotted owls in relation to forest stand characteristics. Journal of Wildlife Management.

Blakesley, J.A. and Noon, B.R. 2004. Comments on Sierra Nevada Forest Plan Amendment – Final Supplemental Environmental Impact Statement. April 25, 2004.

Bolsinger, C. L. 1978. Forest area and timber resources of the San Joaquin area, California (Resource Bulletin RB-PNW-75). Portland: USDA Forest Service, Pacific Northwest Forest and Range Experiment Station.

Bond, M.L., R.J. Gutiérrez, A.B. Franklin, W.S. LaHaye, C.A. May, M.E. Seamans. 2002. Short-term effects of wildfire on spotted owl survival, site fidelity, mate fidelity, and reproductive success. Wildlife Society Bulletin, 30(4): 1022-1028.

Bond, M. 2003. Comments on the Sierra Nevada Forest Plan Amendment Draft Supplemental Environmental Impact Statement. September 10, 2003.

Britting, S. A. 2002. Assessment of timber harvest plans within the summer range of California spotted owl in the Sierra Nevada. Unpublished report. Coloma, California. September 10, 2002.

Britting, S. A. 2003. Overview of recent timber harvest on private lands in the central Sierra Nevada. Unpublished report. Coloma, California. August 3, 2003.

Britting, S. A. 2004. Analysis of the Historic Fire Data Used in the Final Supplemental Environmental Impact Statement for the Sierra Nevada Forest Plan Amendment. April 15, 2004.

Burnham, K. P., D. R. Anderson, and G. C. White. 1996. Meta-analysis ofvital rates of the northern spotted owl. Studies in avian biology, **17**, 92-101.

California Department of Forestry and Fire Protection 2003. GIS data for timber harvest plans in the Southern Forest District 1990-2002. July 29, 2003.

California Department of Forestry and Fire Protection 2004. GIS data for timber harvest plans in the Southern Forest District 1992-2003. July 19, 2004.

California Resources Agency 2003. Comments on the Sierra Nevada Forest Plan Amendment Draft Environmental Impact Statement. June 2003.

Call, D. R. 1990. Home range and habitat use by California spotted owls in the central Sierra Nevada. Unpublished Thesis, Humboldt State University.

Call, D. R., R. J. Gutiérrez, and J. Verner. 1992. Foraging habitat and home range characteristics of California spotted owls in the Sierra Nevada. Condor, **94**, 880-888.

Carey, A. B. 1991. The biology of arboreal rodents in Douglas-fir forests (General Technical Report PNW-GTR-276): USDA Forest Service.

Carey, A. B. 1995. Sciurids in Pacific northwest managed and old growth forests. Ecological Applications, **5**, 648-661.

CDC. 2004. West Nile Virus avian mortality database. Center for Disease Control. Available at: http://www.cdc.gov/ncidod/dvbid/westnile/birdspecies.htm

Christensen, N. L., Swetman, T. W., Erman, D. E., Perry, D., Morgan, P., Stephens, S., Omi, P. N., Graumlich, L., Romme, W. H., Zedler, P. H., Kauffman, J. B., and Baker, W. L. 2002. Letter to President Bush regarding the scientific basis for efforts to reduce risks from catastrophic wildfire. September 24, 2002.

Cole, B. P. 1908. Collection of spotted owl eggs from San Onofre, San Diego, Co., California. .

Commission, L. H. 1994. Timber harvest plans: a flawed effort to balance economic and environmental needs .

committee, W. s. 1994. Report to the California board of forestry: approaches to wildlife cumulative effects assessment and analysis . Davis, California: University of California Davis.

Covington, W. W., and M. M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. Journal of Forestry, **92**, 39-47.

Dark, S. J., R. J. Gutiérrez, and G. J. G. Jr. 1998. The barred owl (Strix varia) invasion in California. The Auk, **115**(1), 50-56.

Davis, F. W., and D. M. Stoms. 1996. Sierran Vegetation: A Gap Analysis. In W. R. Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 671-690): University of California, Davis.

Dawson, W. L. 1923. The birds of California. Los Angeles: South Moulton Company.

Dawson, W. R., J. D. Ligon, J. R. Murphy, J. P. Myers, D. Simberloff, and J. Verner. 1987. Report of the scientific advisory panel on the spotted owl. The Condor, **89**, 205-229.

Duane, T. P. 1996a. Human Settlement 1850-2040. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 235-360): University of California, Davis.

Duane, T. P. 1996b. Recreation in the Sierra. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 557-610): University of California, Davis.

Dunbar, D. L., B. P. Booth, E. D. Forsman, A. E. Hetherington, and D. J. Wilson. 1991. Status of the spotted owl, *Strix occidentalis*, and barred owl, *Strix varia*, in southwestern British Columbia. Canadian Field-Naturalist, **105**, 464-468.

Eldorado National Forest 2002. Middle Fork Cosumnes Landscape Analysis. USDA Forest Service. Placerville, California. September 2002.

Fischer, W. C., and B. D. Clayton. 1983. Fire ecology of Montana forest habitat types east of the Continental Divide (Gen. Tech. Rep. INT-141). Ogden, Utah: USDA Forest Service, Intermountain Forest and Range Experiment Station.

Flint, H. R. 1925. Fire resistance of northern Rocky Mountain conifers. Idaho Foreste, **7**, 7-10,41-43.

force, W. h. f. p. t. 1990. Recommendation to the California state board of forestry on the management of wildlife habitats under the forest practices act .

Forsman, E. D. 1976. A preliminary investigation of the spotted owl in Oregon. Unpublished M.S. Thesis, Oregon State University, Corvallis.

Forsman, E. D. 1981. Molt of the spotted owl. The Auk, **98**, 735-742.

Forsman, E. D., Cooper Ornithological Society., and United States. Forest Service. 1996. Demography of the Northern Spotted Owl : proceedings of a workshop, Fort Collins, Colorado, December 1993. [Los Angeles]: Cooper Ornithological Society.

Forsman, E. D., E. C. Meslow, and H. M. Wight. 1984. Distribution and biology of the spotted owl in Oregon. Wildlife Monographs, **87**, 1-64.

Forsman, E.D., R.G. Anthony, J.A. Reid, P.J. Loschl, S.G. Sovern, M. Taylor, B.L. Biswell, A. Ellingson, E. C. Meslow, G.S. Miller, K.A. Swindle, J.A. Thrailkill, F.F. Wagner, and D.E. Seaman. Natal and breeding dispersal of northern spotted owls. Wildlife Monographs 149, 1-35.

Franklin, A. B. 1997. Factors affecting temporal and spatial variation in northern spotted owl populations in northwestern California. Unpublished Dissertation, Colorado State University, Fort Collins, CO.

Franklin, A.B. 2003. Comments on demography section for the California spotted owl status review. Submitted via to Phil Detrich, January 12, 2003.

Franklin, A. B., D. R. Anderson, R. J. Gutiérrez, and K. P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. Ecological Monographs.

Franklin, A.B., K.P. Burnham, G.C. White, R.G. Anthony, E.D. Forsman, C. Schwarz, J.D. Nichols, and J. Hines. 1999. Range-wide status and trends in northern spotted owl populations. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Fort Collins, CO, and Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, Corvallis, OR.

Franklin, A.B., R.J. Gutiérrez, J.D. Nichols, M.E. Seamans, G.C. White, G.S. Zimmerman, J.E. Hines, T.E. Munton, W.S. LaHaye, J.A. Blakesley, G.N. Steger, B.R. Noon, D.W.H. Shaw, J.L. Keane, T.L. McDonald, and S. Britting. 2004. Population dynamics of the California spotted owl (*Strix occidentalis occidentalis*): a meta-analysis. Ornithological Monographs, 54, 1-54.

Franklin, J. F., and J. A. Fites-Kaufmann. 1996. Assessment of late-successional forests of the Sierra Nevada. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 627-662): University of California, Davis.

GAO 1988. Public rangelands...Some riparian areas restored but widespread improvement will be slow (Report to congressional requesters: GAO/RCED-88-105). Wahington DC: United States General Accounting Office.

GAO 1999. Western National Forests: a cohesive strategy is needed to address catastrophic wildfire threats. Report to the Subcommittee on Forests and Forest Health, Committee on Resources, House of Represenatives. GAO/RCED-99-65. Washington D.C. United States General Accounting Office.

Gladen, J.T. 2003. Memorandum from James T. Gladen, Director, Watershed, Fish, Wildlife, Air and Rare Plants, to Kathleen Morse, Interdisciplinary Team Leader, Subject: Watershed, Fish, Wildlife, Air and Rare Plants Staff comments on the Sierra Nevada Forest Plan Amendment draft supplemental environmental impact statement. September 12, 2003.

Goodman, D. 1987. The demography of chance extinction. In M. E. Soule (Ed.), *Viable populations for conservation* (pp. 69-86). Cambridge: Cambridge University Press.

Gould, G. 1998. California spotted owl coverage : California Department of Fish and Game Watershed Restoration Branch, November 1998.

Gould, G. 1999. California spotted owl coverage for the Sierra Nevada : California Department of Fish and Game Watershed Restoration Branch, September 1999.

Gould, G. J. 1977. Distribution of the spotted owl in California. Western Birds, **8**, 131-146.

Gremel, S. 2003. The effects of barred owls on spotted owls in Olympic National Park, Washington. Presentation to Sustainable Ecosystems Institute, December 12, 2003, Vancouver, WA. Available at: http://www.sei.org/owl/meetings.htm

Gutiérrez, R. J. 1989. Hermatozoa from the spotted owl. Journal of Wildlife Diseases, **25**, 614-618.

Gutiérrez, R. J. 1994. Changes in distribution and abundance of spotted owls. Studies in Avian Biology, **17**.

Gutiérrez, R. J., A. B. Franklin, and W. S. LaHaye. 1995. The spotted owl (*Strix occidentalis*). The Birds of North America, **179**.

Gutiérrez, R. J., and S. Harrison. 1994. Applying metapopulation theory to spotted owl management: a history and critique. In D. R. McCullough (Ed.), *Metapopulations and wildlife conservation* (pp. 167-185). Washington, D.C.: Island Press.

Gutiérrez, R. J., J. E. Hunter, G. Chavez-Leon, and J. Price. 1998. Characteristics of spotted owl habitat in landscapes disturbed by timber harvest in northwestern California. Journal of Raptor Research, **32**(2), 104-110.

Gutiérrez, R. J., W. S. Lehaye, and G. Zimmerman. 1999a. Demography of the California spotted owl in the San Bernardino Mountains (Final Report to the USDA FOrest Service). Arcata, CA: Humboldt State University.

Gutiérrez, R. J., and J. Pritchard. 1990. Distribution, density and age structure of spotted owls on two southern California habitat islands. Condor, **92**, 491-495.

Gutiérrez, R. J., M. E. Seamans, and M. Z. Peery. 2003. Population ecology of the California spotted owl in the central Sierra Nevada: annual results 2002. University of Minnesota, St. Paul, MN.

Gutiérrez, R. J., J. Verner, K. S. McKelvey, B. R. Noon, G. N. Steger, D. R. Call, W. S. Lehaye, B. B. Bingham, and J. S. Sensor. 1992. Habitat relations of the California spotted owl. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 79-98): USDA Forest Service, Pacific Southwest Research Station.

Haig, S.M., R.S. Wagner, E.D. Forsman, and T.D. Mullins. 2001. Geographic variation and genetic structure in spotted owls. Conservation Genetics, 2: 25-40.

Haig, S.M., T.D. Mullins, and E.D. Forsman. In press. Subspecifc relationships and genetic structure in spotted owls. Conservation Biology

Hanley, T. H., and J. L. Page. 1982. Differential effects of livestock use on habitat structure and rodent populations in Great Basin Communities : California Fish and Game 68.

Hedlund, C. D. 1996. Relative proportion of prey species in the diet of spotted owl *Strix occidentalis occidentalis* in the San Gabriel Mountains of southern California. Unpublished Dissertation, California State Polytechnic University, Pomona.

Heller, E. 1893. Egg collection from a nest in cottonwood tree near Riverside, California. The OOlogist.

Helms, J. A., and J. C. Tappeiner. 1996. Silviculture in the Sierra Nevada. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 439-476): University of California, Davis.

Hirt, P. W. 1994. A conspiracy of optimism: management of national forests since World War Two. Lincoln, Nebraska: University of Nebraska Press.

Hunsaker, C.T., B.B. Boroski, and G.N. Steger. 2002. Relations between canopy cover and the occurrence and productivity of California spotted owls. In J.M. Scott, P.L. Heglund, M.L. Morrison, J.B. Haufler, M.G. Raphael, W.A. Wall, F.B. Samson, editors, Predicting species occurrences: issues of accuracy and scale. Island Press, Washington, DC.

Irwin, L.L., and D. Rock. 2003. Foraging habitat selection by California spotted owls. In Adaptive management monitoring of spotted owls, annual progress report. National Council for Air and Stream Improvement, Inc. Corvallis, OR.

Johnsgard, P. 1988. North American owls: biology and natural history. Washington, D.C.: Smithsonian Institution Press.

Johnson, D. H. 1992. Spotted owls, great-horned owls, and forest fragmentation in the central Oregon Cascades. Unpublished Master's thesis, Oregon State University, Corvallis.

Johnson, K. 2003. Comments on the status of the California spotted owl. Email from Kurt Johnson, U.S. Fish and Wildlife Service, to Scott Hicks, U.S. Fish and Wildlife Service. February 3, 2003.

Johnson, S. E. 1982. Impacts of domestic livestock on small mammals of forest grazing allotments in southeastern Idaho. In J. M. Peek & P. D. Dalke (Eds.), *Wildlife-livestock relationships symposium* . Moscow, ID: University of Idah, Forest and Wildlife Range Experiment Station.

Jr., J. P. W., R. J. Gutiérrez, and B. R. Noon. 1998. Habitat selection by northern spotted owls: the consequences of prey selection and distribution. The Condor, **100**, 79-92.

Kelly, K., E.D. Forsman, and R. Anthony. 2003. Is the barred owl displacing the northern spotted owl? Presentation to Sustainable Ecosystems Institute, December 12, 2003, Vancouver, WA. Available at: http://www.sei.org/owl/meetings.htm

Kilgore, B. M., and D. Taylor. 1979. Fire history of a sequoia-mixed conifer forest. Ecology, **60**(1), 129-142.

LaHaye, W.S. 1999. Project leader demography study of California spotted owl in the San Bernardino Mountains.

LaHaye, W.S. 2003a. Results of spotted owl surveys in the San Bernardino National Forest during the spring and summer 2003. Contract No. 53-9A14-3-IL037, San Bernardino National Forest.

LaHaye, W.S. 2003b. Comments on the demography section for the California spotted owl status review. Submitted via email to Phil Detrich, U.S. Fish and Wildlife Service, January 10, 2003.

LaHaye, W. S., and R. J. Gutiérrez. 1999. Nest sites and nesting habitat of the northern spotted owl in northwestern California. The Condor, **101**, 324-330.

LaHaye, W.S., G.S. Zimmerman, and R. J. Gutiérrez. In press. Temporal variation in an insular population of spotted owls: contrasting effects of weather. The Auk.

Lande, R. 1988. Demographic models of the northern spotted owl (*Strix occidentalis caurina*). Oecological, **75**, 601-607.

Lande, R. 1993. Risks of population extinction from demographic and environmental stochasticity and random catastrophes. American Naturalist, **142**, 911-927.

Langley, P. G. 1996. Quality Assessment of late seral old growth forest mapping. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.....* (pp. 663-670): University of California, Davis.

Laymon, S. A. 1988. Ecology of the spotted owl in the central Sierra Nevada. Unpublished Dissertation, University of California, Berkely.

Lee, D.C. 2001. Comments on the Hunsaker et al. manuscript, "Relations Between Occurrence and Productivity of California Spotted Owls and Canopy Cover," and its use in the FEIS. Letter to Kent Connaughton and Peter Stine, Sierra Nevada Framework for Conservation and Collaboration, USDA Forest Service.

Lee, D.C., and L.L. Irwin. In review. Implications of Forest Thinning on Spotted Owls in Fire-Adapted Forests of the Western United States. USDA Forest Service Pacific Southwest Research Station.

LeHaye, W. S., R. J. Gutiérrez, and H. R. Akcakaya. 1994. Spotted owl metapopulation dynamics in southern California. Journal of Animal Ecology, **63**, 775-785.

LeHaye, W. S., R. J. Gutiérrez, and D. R. Call. 1997. Nest-site selection and reproductive success of California spotted owls. Wilson Bulletin, **109**(1), 42-51.

Leiberg, J. B. 1902. Forest conditions in the northern Sierra Nevada, California (Professional Paper No. 8, Series H, Forestry, 5). Washington, D.C.: Department of the Interior, United States Geological Survey.

Leskiw, T., and R. J. Gutiérrez. 1998. Possible predation of a spotted owl by a barred owl. Western Birds, **29**, 225-226.

MacArthur, R. H., and E. O. Wilson. 1967. The theory of island biogeography. Princeton, NJ: Princeton University Press.

Madany, M. H., and N. E. West. 1983. Livestock grazing - fire regime interactions within montane forests of Zion National Park, Utah. Ecology, **64**(661-667).

Madany, M. H. a. N. E. W. 1983. Livestock grazing - fire regime interactions within montane forests of Zion National Park, Utah. Ecology, **64**, 661-667.

Marshall, J. T. 1942. Food and habitat of the spotted owl. Condor, **44**, 66-67.

Maser, C., R. Anderson, K. C. Jr., J. T. Williams, and R. E. Martin. 1978. Dead and down wood material. In J. W. Thomas (Ed.), *Wildlife habitats in managed forests--the Blue Mountains of Oregon and Washington* . Portland: USDA Forest Service Pacific Northwest Forest and Range Experiment Station.

May, R. H. 1953. A century of lumber production in California and Nevada (Forest Survey Release No. 20): USDA Forest Service, California Forest and Range Experiment Station.

McBride, J. R., W. Russell, and S. Kloss. 1996. Impact of human settlement on forest composition and structure. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 1193-1202): University of California, Davis.

McKelvey, K. S., and K. K. Busse. 1996. Twentieth-century fire patterns on Forest Service lands. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 1119-1138): University of California, Davis.

McKelvey, K. S., and J. D. Johnston. 1992. Historical perspectives on forests of the Sierra Nevada and the Transverse Ranges of southern California: forest condition at the turn of the century. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 225-246): USDA Forest Service, Pacific Southwest Research Station.

Menning, K., N. K. Johnson, and L. Ruth. 1997. A review of current non-federal policies on non-federal lands in the Sierra Nevada that affects aquatic, riparian, upland and late successional biological diversity. . Davis, California: Center for Water and Wildland Resources, University of California Davis.

Minnich, R. A., M. G. Barbour, J. H. Burk, and R. F. Fernau. 1995. Sixty years of change in Californian conifer forests of the San Bernardino Mountains. Conservation Biology, **9**, 902-914.

Moen, C. A., and R. J. Gutiérrez. 1997. California spotted owl habitat selection in the central Sierra Nevada. Journal of Wildlife Management, **61**(4), 1281-1287.

NAS. 2004. Information on West Nile Virus available at http://www.audubon.org/bird/wnv/.

Noon, B. 2000. Letter with updated results of demography study of California spotted owls on the Lassen National Forest.

Noon, B.R. 2004. Letter to Jack Blackwell. April 25, 2004.

Noon, B. R., and C. M. Biles. 1990. Mathematical demography of spotted owls in the Pacific Northwest. Journal of Wildlife Management, **54**, 18-27.

Noon, B. R., and J. A. Blakesley. 1999. Demographic parameters of the California spotted owl on the Lassen National Forest; preliminary results (1990-1998) (Summary Report). Arcata, CA: USDA Forest Service, Pacific Southwest Research Station.

Noon, B. R., and K. S. McKelvey. 1992. Stability properties of the spotted owl metapopulation in southern California. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 187-206): USDA Forest Service, Pacific Southwest Research Station.

North, M., G. Steger, R. Denton, G. Eberlein, T. Munton, and K. Johnson. 2000. Association of weather and nest site structure with reproductive success in California spotted owls. Journal of Wildlife Management, V. 64(3): 797-807.

Page, J. L., et. al. 1978. The influence of livestock grazing on non-game wildlife. : Cal.-Neva. Wildlife.

Parsons, D. J., and S. H. DeBenedetti. 1979. Impact of fire suppression on a mixed conifer forest. Forest Ecology and Management, **2**, 21-33.

Payton, L. G. 1909. Collection of spotted owl eggs from Fish Canyon, Los Angeles CO., California. .

Payton, L. G., and I. D. Nokes. 1925. Collection of spotted owl eggs from nest in rocky cliff, Fish Canyon, Los Angeles CO., California.

Pearson, R.R., and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. Presentation to Sustainable Ecosystems Institute, December 12, 2003, Vancouver, WA. Available at: http://www.sei.org/owl/meetings.htm

Peery, Z. 1999. Declaration on the Draft Environmental Impact Statement for the Herger-Feinstein Quincy Library Group Forest Recovery Act .

Peery, Z. 2004. Declaration of Zach Peery, M.S. April 25, 2004.

Peery, Z., R. J. Gutiérrez, and M. E. Seamans. 1999. Habitat composition and configuration around Mexican spotted owl nest and roost sites in the TUlarosa Mountains, New Mexico. Journal of WIldlife Management, **63**(1), 36-43.

Peterson, A.T., and C.R. Robins. 2003. Using ecological-niche modeling to predict barred owl invasions with implications for spotted owl conservation. Conservation Biology, V. 17(4): 1161-1165.

Powell, D. S., J. L. Faulkner, D. R. Darr, Z. Zhu, and D. W. MacCleery. 1992. Forest Resources of the United States (General Technical Report GTR-RM-234). Fort Collins, CO: USDA Forest Service.

Powell, D. S., J. L. Faulkner, D. R. Darr, Z. Zhu, and D. W. MacCleery. 1993. Forest Resources of the United States (General Technical Report RM-234). Fort Collins, CO: USDA Forest Service Rocky Mountain Forest and Range Experiment Station.

PRIME California Inventory Data 1997. Pacific Northwest Research Station, USDA forest Service. Portland, OR.

Rosenstock, S. S. 1996. Habitt relationships of breeding birds in northern Arizona pondersa pine and pine-oak forests (Technical Report 23). Phoenix: Arizona Game and Fish Department.

Rummell, R. S. 1951. Some effects livestock grazing on ponderosa pine forest and range in central Washington. Ecology, **32**, 594-607.

Rice, C. 2003. Comments on the Sierra Nevada Forest Plan Amendment Draft Supplemental Environmental Impact Statement. September 8, 2003

Rice, C. 2004. Declaration of Carol Rice, M.S. April 27, 2004.

Schulz, T. T., and W. C. Leininger. 1991. Nongame wildlife communities in grazed and ungrazed montane riparian sites. Great Basin Naturalist, **51**(3), 286-292.

Scott, J. H. 1998. Fuel reduction in residential and scenic forests: a comparison of three treatments in a western Montana ponderosa pine stand (Research paper RMRS-RP-5): USDA Forest Service Rocky Mountain Research Station.

Seamans, M. E., and R. J. Gutiérrez. 1999. Diet composition and reproductive success of Mexican spotted owls. Journal of Raptor Research, **33**(2), 143-148.

Seamans, M. E., R. J. Gutiérrez, C. A. May, and M. Z. Peery. 1999. Demography of two Mexican spotted owl populations. Conservation Biology, **13**(4), 744-754.

Seamans, M.E., R. J. Gutiérrez, C.A. Moen, M.Z. Peery. 2001. Spotted owl demography in the central Sierra Nevada. Journal of Wildlife Management, 65(3):425-431.

Sechrist, E. E. 1938. Collection of spotted owl eggs from Fanita Ranch, San Diego California. San Bernardino County Museum.

Sierra Nevada Forest Protection Campaign et al. 2004. Appeal of the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Report and Record of Decision. April 29, 2004.

Shaffer, M. L. 1987. Minimum viable populations: coping with uncertainty. In M. E. Soule (Ed.), *Viable populations for conservation* (pp. 69-86). Cambridge: Cambridge University Press.

Smith, J. J. 1989. Recovery of riparian vegetation on an intermittent stream following removal of cattle. (General Technical Report PSW-110): USDA Forest Service.

Smith, R. B., M. Z. Peery, R. J. Gutiérrez, and W. S. LaHaye. 1999. The relationship between spotted owl diet and reproductive success in the San Bernardino Mountains, California. Wilson Bulletin, **111**(1), 22-29.

Sierra Pacific Industries 1999. Option A demonstration of maximum sustainable production for all lands managed by Sierra Pacific Industries in the Northern State Forest District. Sierra Pacific Industries. Redding, CA. January 1, 1999.

Sierra Pacific Industries 2002. Data submitted to the US Fish and Wildlife Service in response to the call for information regarding the California spotted owl. Source: USFWS project file.

Stacey, P. B., and A. Hodgson. unpublished report. Impact of a large natural wildfire on the Mexican spotted owl . Reno, NV: Department of Environmental and Resource Sciences, University of Nevada.

Steger, G. N., T. E. Munton, G. P. Eberlein, and K. D. Johnson. 2000. A study of spotted owl demographics in the Sierra National Forest and Sequoia and Kings Canyon National Parks (Annual Progress Report). Fresno, CA: USDA Forest Service, Pacific Southwest Research Station.

Steger, G. N., T. E. Munton, G. P. Eberlein, and K. D. Johnson. 2002. A study of spotted owl demographics in the Sierra National Forest and Sequoia and Kings Canyon National Parks (Annual Progress Report). Fresno, California: USDA Forest Service, Pacific Southwest Research Station.

Stephenson, J. 1991. Spotted owl surveys on the national forests of southern California: a status report and recommendations for the future . San Bernardino, CA: USDA Forest Service.

Stephens, S. L. 1998. Evaluation of the effects of silvicultural and fuels treatments on potential fire behavior in Sierra Nevada mixed-conifer forests. Forest Ecology and Management 105(1998): 21-35.

Stine, P. A. and Keane, J. 2003. Science Consistency Report. Draft supplemental environmental impact statement, Sierra Nevada Forest Plan Amendment. Content pertaining to California spotted owls as of October 20th, 2003. November 3, 2004.

Sudworth, G. B. 1900. Stanislaus and Lake Tahoe Forest Reserves, Califronia and Adjacent Territory (Twenty-first annual report to the Secretary of the Interior Part V--Forest Reserves). Washington, D.C.: United States Geological Survey.

Swetnam, T. W., and C. H. Baisan. 1994. Historical fire regime patterns in the Southwestern United States since AD 1700. Paper presented at the Fire effects in Southwestern forests: proceedings of the second La Mesa Fire symposium. USDA Forest Service Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-GTR-286, Los Alamos, New Mexico.

Swetnam, T. W., C. H. Baisan, K. Morino, and A. C. Caprio. 2000a. Fire history along an elevational transects in the Sierra Nevada, California (Final Report): Sierra Nevada Global Change Research Program, USGS Biological Resources Division, Sequoia. Kings Canyon and Yosemite National Parks.

Swetnam, T. W., C. H. Baisan, K. Morino, and A. C. Caprio. 2000b. Fire history along elevational transects in the Sierra Nevada, California (Final Report to Sierra Nevada Global Change Research Program, USGS Biological Resources Division, Sequoia, Kings Canyon and Yosemite National Parks). Tucson, AZ: Laboratory of Tree-Ring Research, University of Arizona.

SYMVCD. 2004. Sacramento-Yolo Mosquito and Vector Control District press release on discovery of West Nile Virus in Sacramento, County, CA. July 22, 2004.

Tahoe National Forest 2003. Borda Project. Environmental assessment. USDA Forest Service. Nevada City, California.

Taylor, A. L., and E. D. Forsman. 1976. Recent range expansion of the barred owl in western North America, including the first records for Oregon. Condor, **78**, 560-561.

Templeton, A. R. 1986. Coadaptation and outbreeding depression. In M. E. Soule (Ed.), *Conservation Biology* (pp. 105-116). Sunderland, MA: Sinauer Associates.

Thomas, C. 2000. Personal communication: Center for Sierra Nevada Conservation.

Thomas, J. W., E. D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Portland, OR: Interagency Scientific Committee to address the conservation of the northern spotted owl.

Thrailkill, J., and M. A. Bias. 1989. Diets of breeding and nonbreeding California spotted owls. Journal of Raptor Research, **23**, 39-41.

Ting, T.-F. 1997. The thermal environment of northern spotted owls in northwestern California: possible explanations for use of interior old growth and coastal early-successional stage forest. Unpublished M.S. Thesis, Humboldt State University, Arcata, CA.

Touchan, R., T. W. Swetnam, and H. D. Grissino-Mayer. 1993. Effects of livestock grazing on pre-settlement fire regimes in New Mexico. Paper presented at the Fire in wilderness and park management symposium, Missoula, MT. USDA Forest Service Intermountain Research Station, General Technical Report INT-GTR-320.

USDA. 1993. Decision notice and finding of no significant impact for California spotted owl Sierran Province Interim Guidelines. USDA Forest Service Pacific Southwest Region.

USDA. 1996. Revised Draft Environmental Impact Statement: managing California spotted owl habitat in the Sierra Nevada National Forests of California : USDA Forest Service, Pacific Southwest Region.

USDA. 1997. Final Report of the California spotted owl Federal Advisory Committee : USDA Forest Service, Pacific Southwest Region.

USDA Forest Service 1999a. Record of Decision. Herger-Feinstein Quincy Library Group Forest Recovery Act Final Environmental Impact Statement. Pacific Southwest Region. August 1999.

USDA Forest Service 1999b. Herger-Feinstein Quincy Library Group Forest Recovery Act, Final Environmental Impact Statement. Pacific Southwest Region. August 1999.

USDA. 2001. Sierra Nevada Forest Plan Amendment final supplemental environmental impact statement record of decision. USDA Forest Service, Pacific Southwest Region. January, 2001.

USDA Forest Service 2003. Sierra Nevada Forest Plan Amendment management review and recommendations. Pacific Southwest Region, R5-MB-012, March 2003.

USDA. 2004a. Sierra Nevada Forest Plan Amendment final supplemental environmental impact statement record of decision. USDA Forest Service, Pacific Southwest Region, R5-MB-046, January 2004.

USDA. 2004b. Draft environmental impact statement for revised land management plans: Angeles, Cleveland, Los Padres, San Bernardino National Forests. USDA Forest Service, Pacific Southwest Region, R5-MB-051, May 2004.

U.S. Environmental Protection Agency 2003. Comments on draft supplemental environmental impact statement for the Sierra Nevada Forest Plan Amendment. CEQ #030263. U.S. EPA, Region IX. September 23, 2003.

USFWS. 1995. Recovery Plan for the Mexican spotted owl (Vol. I). Albuquerque, NM: USDI Fish and Wildlife Service.

USFWS. 1990. Endangered and threatened wildlife and plants; determination of threatened status for the northern spotted owl (Vol. 55,): Federal Register.

USFWS. 1993. Endangered and threatened wildlife and plants; final rule to list the Mexican spotted owl as a threatened species (Vol. 58,): Federal Register.

USFWS. 1998. Status review of the northern goshawk. Portland, OR: U.S. Fish and Wildlife Service.

USFWS. 2001. Formal Endangered Species Consultation and Conference on the Biological Assessment for the Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement. U.S. Department of Interior Fish and Wildlife Service. January 11, 2001.

USFWS. 2003a. Endangered and Threatened Wildlife and Plants; 12-Month Finding for a Petition To List the California Spotted Owl (Strix occidentalis occidentalis). U.S. Fish and Wildlife Service. Federal Register: February 14, 2003, V. 68, No. 31: 7580-7608.

USFWS. 2003b. Comments on the Sierra Nevada Forest Plan Amendment, Draft Supplemental Environmental Impact Statement. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office. September 12, 2003.

Vankat, J. L. 1977. Fire and Man in Sequoia National Park. Annals of the Association of American Geographers, **67**, 17-27.

van Wagtendonk, J. W. 1996. Use of a deterministic fire growth model to test fuel treatments. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options.* (pp. 1155-1166): University of California, Davis.

Verner, J. 1999. Review of "A preliminary report on the status of the California spotted owl in the Sierra Nevada." . Fresno, California: USDA Forest Service Pacific Southwest Research Station Forestry Sciences Laboratory.

Verner, J. 2003. Letter to Regional Forester Jack Blackwell. August 31, 2003.

Verner, J. 2004. Letter to Jack Blackwell, Regional Forester. April 18, 2004.

Verner, J., R. J. Gutiérrez, and G. I. G. Jr. 1992a. The California spotted owl: general biology and ecological relations. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 55-78): USDA Forest Service, Pacific Southwest Research Station.

Verner, J., K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., and T. W. Beck. 1992b. Assessment of the current status of the California spotted owl, with recommendations for management. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 3-26): USDA Forest Service, Pacific Southwest Research Station.

Verner, J., G. N. Steger, G. B. Eberlein, D. A. Leal, and T. E. Munton. 1991. Annual progress report 1990: spotted owl home range size and composition in the Sierra National Forest; demography of spotted owls in the Sierra National Forest and Sequoia/Kings Canyon National Parks. USDA Forest Service Pacific Southwest Forest and Range Experiment Station.

Waddell, K. L., and P. M. Bassett. 1997. Timber resource statistics for the San Joaquin and southern resource areas of California (Resource Bulletin PNW-RB-224): USDA Forest Service, Pacific Northwest Research Station.

Wasser, S. K., K. Bevis, G. King, and E. Hanson. 1997. Noninvasive physiological measures of disturbance in the northern spotted owl. Conservation Biology, **11**(4).

Weatherspoon, C. P., S. J. Husari, and J. W. van. Wagtendonk. 1992. Fire and fuels management in relation to owl habitat in forests of the Sierra Nevada and southern California. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 247-260): USDA Forest Service, Pacific Southwest Research Station.

Weigl, P. D., and D. W. Osgood. 1974. Study of the northern flying squirrel *Glaucomys sabrinus* by temperature telemetry. American Midland Naturalist, **92**, 482-486.

WGLSCS. 1996. Working Group on Late-Successional Conservation Strategies. In Wildland Resources Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, Adendum, Assessments and Scientific Basis for Management Options.* : University of California, Davis.

Woodbridge, B. 1999. personal communication : Forest Service Biologist.

Wyant, J. G., P. N. Omi, and R. D. Laven. 1986. Fire induced tree mortality in a Colorado ponderosa pine/douglas-fir stand. Forest Science, **32**, 49-59.

Xantus, J. 1859. Catalogue of birds collected in the vicinity of Fort Tejon, California, with a description of a new species of Syrnium. Proceedings of the Academy of Natural Sciences of Philadelphia.

Zabel, C. J., G. N. Steger, K. S. McKelvey, G. P. Eberlein, B. R. Noon, and J. Verner. 1992. Home-range size and habitat-use patterns of California spotted owls in the Sierra Nevada. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutiérrez, G. I. G. Jr., & T. W. Beck (Eds.), *The California spotted owl: a technical assessment of its current status* (Vol. General Technical Report, PSW-GTR-133, pp. 149-164): USDA Forest Service, Pacific Southwest Research Station.

Zimmerman, G.S. 2003. Comments on the demography section for the California spotted owl status review. Submitted via email to Phil Detrich, U.S. Fish and Wildlife Service, January 13, 2003.

Zimmerman, G.S., W.S. LaHaye, R.J. Gutiérrez. 2003. Empirical support for a despotic distribution in a California spotted owl population. Behavioral Ecology Vol. 14 No. 3: 433–437.

Attachments:

1. Appendix A. Summaries of private land harvest documents within two miles of 20 owl sites within four 'areas of concern"

2. Britting, S. A. 2002. Assessment of timber harvest plans within the summer range of California spotted owl in the Sierra Nevada. Unpublished report. Coloma, California. September 10, 2002.

3. Britting, S. A. 2003. Overview of recent timber harvest on private lands in the central Sierra Nevada. Unpublished report. Coloma, California. August 3, 2003.

4. Sierra Nevada Forest Protection Campaign et al. 2004. Appeal of the Sierra Nevada Forest Plan Amendment Final Supplemental Environmental Impact Report and Record of Decision. April 29, 2004.

Appendix A. Summaries of private land harvest documents within two miles of 20 owl sites within four 'areas of concern" (Beck and Gould 1992).

Table 1. Summary of harvest documents within 2 miles of 5 selected owl sites in AOC 2. Overlap in harvest areas exists between owl sites, and the sum of the total acres or plans reflects an overestimate of acres represented in the harvest documents.

Owl Site	Type of Plan	Plans filed documenting harvest units w/in 2 miles of owl site	Acreage of plans documenting harvest units w/in 2 miles of owl site	Plans filed documenting harvest units w/in 0.5 miles of owl site	Estimate of harvest acres w/in 2 miles of owl site	Primary Logging Method	Documents referring to owls	Reference to owls	Documents identifying owl location	Documents identifying LSOG forest	Acres of LSOG forest identified	Acres of LSOG forest cited as impacted
PL001	THP	1	1,727	1	0	SW, CT	0	none	0	0	0	0
	EX	11	206,901	10	26,740	D/D/D	0	none	0	0	0	0
	EM	5	4,925	3	0	SS	0	none	0	0	0	0
	TOTAL	**17**	**213,553**	**14**	**26,740**							
PL053	THP	0	0	0	0							
	EX	4	154,199	4	20,734	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0		0	none	0	0	0	0
	TOTAL	**4**	**154,199**	**4**	**20,734**							
PL164	THP	4	6,597	0	2,478	S	4		0	1	0	0
	EX	21	331,010	0	16,119	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**25**	**33,7607**	**0**	**18,597**							
PL306	THP	2	11,280	0	820	S	2		1	0	0	0
	EX	7	334,261	1	20,714	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**9**	**34,5541**	**1**	**21,534**							
TE096	THP	1	4,540	1	1,237	T	1		1	1	0	0
	EX	13	282,519	6	38,020	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**14**	**287,059**	**7**	**39,257**							

SW - shelterwood
CT - commercial thin
S - selection
D/D/D - harvest of dead, disease, and dying

Table 2. Summary of harvest documents within 2 miles of 5 selected owl sites in AOC 3. Overlap in harvest areas exists between owl sites, and the sum of the total acres or plans reflects an overestimate of acres represented in the harvest documents.

Owl Site	Type of Plan	Plans filed containing harvest units w/in 2 miles of owl site	Acreage of plans documenting harvest units w/in 2 miles of owl site	Plans filed w/in 0.5 miles of owl site	Estimate of harvest acres w/in 0.5 miles of owl site	Primary Logging Method	Documents referring to owls	Reference to owls	Documents identifying owl location	Documents identifying LSOG forest	Acres of LSOG forest identified	Acres of LSOG forest cited as impacted
PC045	THP	10	2,583	10	1,795	S, CC	6	General, specific	1	2	70	0
	EX	1	3	1	3	C	0	none	0	0	0	0
	EM	1	20	1	20	ST	0	none	0	0	0	0
	TOTAL	**12**	**2,606**	**12**	**1,818**							
SI042	THP	1	560	1	560	CC	1	General	0	0	0	0
	EX	2	15,440	2	8,320	D/D/D	0	none	0	0	0	0
	EM	0										
	TOTAL	**3**	**16,000**	**3**	**8,880**							
SI043	THP	0										
	EX	3	4,623	3	2,712	D/D/D	0	none	0	0	0	0
	EM	0										
	TOTAL	**3**	**4,623**	**3**	**2,712**							

D/D/D - harvest of dead, disease, and dying
S - selection
ST - seed tree removal
CC - clearcut

Table 3. Summary of harvest documents within 2 miles of 5 selected owl sites in AOC 4. Overlap in harvest areas exists between owl sites, and the sum of the total acres or plans reflects an overestimate of acres represented in the harvest documents.

Owl Site	Type of Plan	Plans filed containing harvest units w/in 2 miles of owl site	Acreage of plans documenting harvest units w/in 2 miles of owl site	Plans filed documenting harvest units w/in 0.5 miles of owl site	Estimate of harvest acres w/in 2 miles of owl site	Primary Logging Method	Documents referring to owls	Reference to owls	Documents identifying owl location	Documents identifying LSOG forest	Acres of LSOG forest identifie d	Acres of LSOG forest cited as impacted
ED014	THP	9	3,760	3	1,326	CC	7	General, specific	2	1	0	0
	EX	54	78,184	7	87	O, D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**63**	**81,944**	**10**	**1,413**							
ED045	THP	9	6,851	1	4,932	CT, SW	5	General, specific	2	1	30	15
	EX	21	210,574	7	7	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**30**	**217,425**	**8**	**4,939**							
ED198	THP	19	4,589	6	4,147	CC, S	6	General, specific	4	1	0	0
	EX	20	247,089	10	47	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**39**	**251,678**	**16**	**4,194**							
PC037	THP	9	4,578	5	3,531	CC	9	General, specific	3	1	102	0
	EX	7	272,814	7	70,472	D/D/D	0	none	0	0	0	0
	EM	0	0	0	0							
	TOTAL	**16**	**277,392**	**12**	**74,003**							
PC051	THP	0	0	0	0							
	EX	7	272,841	7	70,472	D/D/D	0	none	0	0	0	0
	EM	0		0	0							
	TOTAL	**7**	**272,841**	**7**	**70,472**							

D/D/D - harvest of dead, disease, and dying O - other S - selection
CT commercial thin SW - shelterwood CC - clearcut

Table 4. Summary of harvest documents within 2 miles of 5 selected owl sites in AOC 5. Overlap in harvest areas exists between owl sites, and the sum of the total acres or plans reflects an overestimate of acres represented in the harvest documents.

Owl Site	Type of Plan	Plans filed containing harvest units w/in 2 miles of owl site	Acreage of plans documenting harvest units w/in 2 miles of owl site	Plans filed documenting harvest units w/in 0.5 miles of owl site	Estimate of harvest acres w/in 2 miles of owl site	Primary Logging Method	Documents refering to owls	Reference to owls	Documents identifying owl location	Documents identifying LSOG forest	Acres of LSOG forest identified	Acres of LSOG forest cited as impacted
CA011	THP	24	12,262	22	5,299	CC	16	General, specific	2	2	0	0
	EX	29	417,187	24	55,584	D/D/D	0	none	0	0	0	0
	EM	5	4,780	0			0	none	0	0	0	0
	TOTAL	**58**	**43,4229**	**46**	**60,883**							
CA032	THP	9	3,501	9	3,107	CC, S	6	General, specific	0	0	0	0
	EX	21	444,701	10	65,419	D/D/D	0	none	0	0	0	0
	EM	2	4,520	0			0	none	0	0	0	0
	TOTAL	**32**	**452,722**	**19**	**68,526**							
TL037	THP	11	7,337	10	3,203	CC	5	Specific	3	1	89	0
	EX	10	152,188	3	25,860	D/D/D	0	none	0	0	0	0
	EM	5		0			0	none	0	0	0	0
	TOTAL	**26**	**159,525**	**13**	**29,063**							
TL152	THP	4	1,411	3	281	CC, ST, CT	1	General	0	1	20	0
	EX	16	112,756	10	18,812	D/D/D	0	none	0	0	0	0
	EM	5	1,102	2			0	none	0	0	0	0
	TOTAL	**25**	**115,269**	**15**	**19,093**							
TL201	THP	21	14,031	18	7,495	CC	14	General, specific	7	2	417	0
	EX	48	422,263	24	47,712	D/D/D	0	none	0	0	0	0
	EM	10	4,475	1	30		0	none	0	0	0	0
	TOTAL	**79**	**440,769**	**43**	**55,237**							

D/D/D - harvest of dead, disease, and dying S - selection
ST - seed tree removal CC – clearcut CT - commercial thin