Petition to list the fisher (*Martes pennanti*) as an endangered species in its West Coast range

Center for Biological Diversity

Sierra Nevada Forest Protection Campaign

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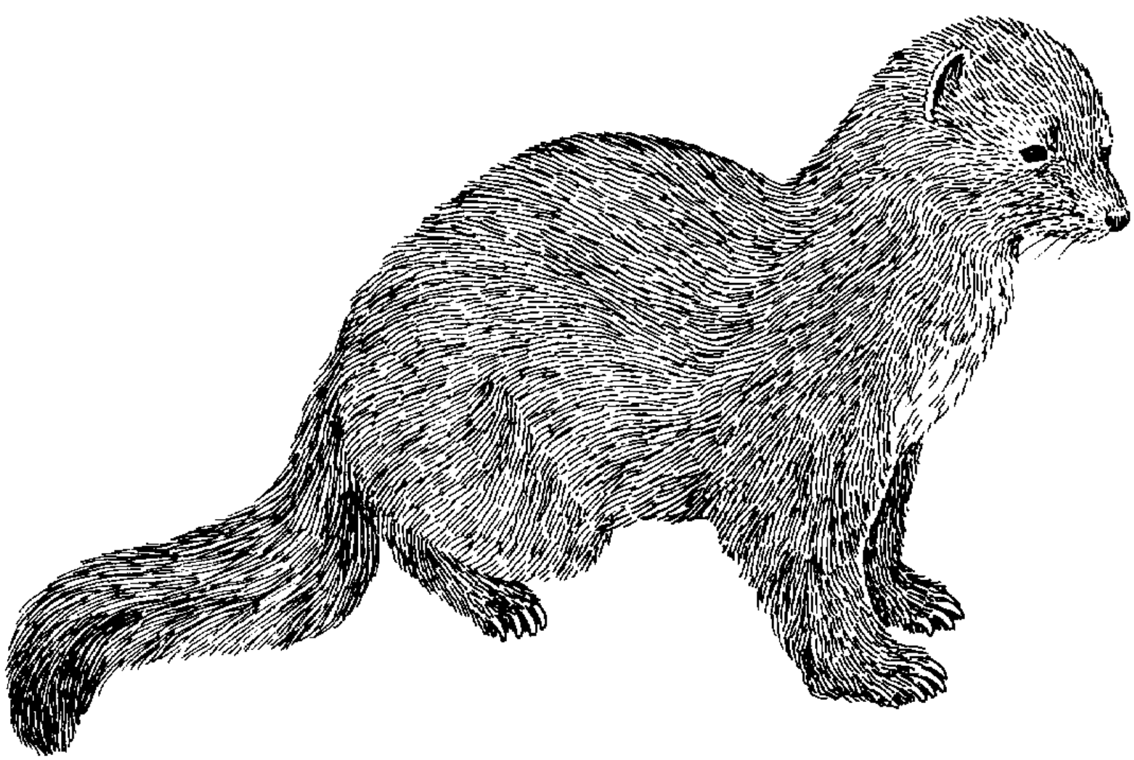

Supporters: American Lands, Biodiversity Legal Foundation, Center for Sierra Nevada Conservation, Friends of the Kalmiopsis, Environmental Protection Information Center, Klamath-Siskiyou Wildlands Center, Natural Resources Defense Council, Northwest Ecosystem Alliance, Oregon Natural Resources Council, Predator Conservation Alliance, Siskiyou Project and Siskiyou Action Project

November 28, 2000

Mr. Bruce Babbitt
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, Noah Greenwald, American Lands, Biodiversity Legal Foundation, Center for Sierra Nevada Conservation, Friends of the Kalmiopsis, Environmental Protection Information Center, Klamath-Siskiyou Wildlands Center, Natural Resources Defense Council, Northwest Ecosystem Alliance, Oregon Natural Resources Council, Predator Conservation Alliance, Siskiyou Project and Siskiyou Action Project hereby formally petition to list a distinct population segment of the fisher *(Martes pennanti)*, including portions of California, Oregon and Washington as 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).

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.

Noah Greenwald is a conservation biologist with the Center for Biological Diversity, who has extensively researched the status and management of the fisher.

American Lands works with conservation organizations and citizens nationwide to protect and recover our wildlife and wild places.

Biodiversity Legal Foundation is a non-profit conservation organization dedicated to the preservation of all native wild plants and animals, communities of species, and naturally functioning ecosystems in this country. Through reasoned educational, administrative, and legal actions, the BLF endeavors to encourage improved attitudes and policies for all living things.

Center for Sierra Nevada Conservation is a grassroots environmental organization located in the central Sierra Nevada dedicated to the protection of ecosystem values and the long-term sustainability of our natural resources for future generations.

Environmental Protection Information Center (EPIC) is a community-based, non-profit organization dedicated to the protection and restoration of the watersheds, biodiversity, native species, and natural ecosystems of the North Coast of California. EPIC was formed in 1977 and currently has more than 3,000 members.

Friends of the Kalmiopsis is a small citizens group working to protect and preserve the rivers, wilderness and roadless areas of the Kalmiopsis Region in southwest Oregon's Siskiyou Mountains.

Klamath-Siskiyou Wildlands Center (KS Wild) exists to defend the globally outstanding biological diversity of the Klamath-Siskiyou ecoregion. We monitor three million acres of public land in the Rogue River basin to ensure that logging, road construction, mining, grazing, and other industrial activities comply with existing environmental laws. We also lobby for the protection of wilderness and the species and processes that sustain wild areas. We use litigation, organizing, and collaborative tactics to achieve our mission.

Natural Resources Defense Council (NRDC) 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.

Northwest Ecosystem Alliance (NWEA) was established in 1988 and is a non-profit 501(c)(3) public interest organization incorporated in the State of Washington. NWEA and its 8,000 members are dedicated to the protection and restoration of biological diversity. NWEA conducts research and advocacy to promote the conservation of sensitive and endangered wildlife and their habitat in the northern Pacific region."

Oregon Natural Resources Council works to aggressively protect and restore the wildlands, wildlife, and waters of the State of Oregon as an enduring legacy.

Predator Conservation Alliance (PCA) is a non-profit conservation organization based in Bozeman, Montana, which works to conserve and restore ecological integrity by protecting predators and their habitats. PCA's geographic region of focus is the High Plains and northern Rockies of the United States.

Siskiyou Project works to protect, preserve and restore the wild free flowing rivers and wildlands of the Siskiyou Mountains and the region's globally important biological diversity and rare plants.

Siskiyou Action Project is a 501 (c)(4) ogranization working to protect wild rivers, wilderness and roadless areas in the Siskiyou Mountains.

Executive Summary

Because of a combination of historic trapping and habitat loss, native populations of the fisher (*Martes pennanti*) have been eliminated from large portions of the West Coast, including likely most of Oregon and Washington and much of California (Aubry et al. 1996, Aubry and Houston 1992, Lewis and Stinson 1998, Zielinski et al. 1997a). Remaining populations, which includes native populations in the southern Sierra Nevada and North Coast/Klamath region of California (Truex et al 1998, Zielinski et al. 1997a) and an introduced population in the southern Oregon Cascades (Aubry et al. 1996), are imperiled by continued habitat loss to logging, road construction and development, poaching, predation, population isolation, and environmental and demographic stochasticity. Current regulations are inadequate to protect existing populations and to ensure recovery of the fisher to a larger and more stable portion of its historic range on the West Coast. Indeed, Powell and Zielinski (1994) concluded:

> "Establishing the reasons for the precarious status of the fisher populations in the Pacific Northwest may not be as important in the short term as making people aware of the status and providing federal protection for the populations. That the populations appear dangerously low should be sufficient to generate protection; discussions and research into the reasons should occur after protection. In our opinion, protection by the states of Washington, Oregon and California has not been sufficient to improve population status."

The fisher in its West Coast range qualifies as a distinct population segment because it is geographically, reproductively and genetically isolated from other fisher populations, occurs in a unique ecological setting and is genetically distinct. In addition, the West Coast harbors the only remaining native populations in the western United States and comprises a significant portion of the fisher's range in the United States. The Endangered Species Act specifies that a distinct population segment of a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)). The fisher in its West Coast range meets all five of these factors:

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

- In the western United States, numerous studies demonstrate that the fisher is closely associated with forested stands that have characteristics typical of late-successional forests, such as large trees, snags and logs, high canopy closure and multiple canopy layers (e.g. Aubry and Lewis in litt., Aubry et al. 1996, Dark 1997, Jones and Garton 1991, Seglund 1995, Truex et al. 1998). Logging and other factors have resulted in the loss of roughly 60-85% of all late-successional forests on the West Coast (Beardsley et al. 1999, FEMAT 1993, Franklin and Fites-Kaufman 1996, Morrison et al. 1991, USDI 1990), resulting in loss and fragmentation of fisher habitat.

- Logging has continued to result in loss of fisher habitat. For example, the six National Forests in California where the fisher still occurs planned at least 148 timber sales that were considered by the Forest Service to potentially harm the fisher since 1993.

- Urban and agricultural development and road construction are continuing to result in further loss and fragmentation of fisher habitat on the West Coast.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

- Although trapping of fishers has been prohibited in California, Oregon and Washington, incidental capture and injury and poaching continue to threaten the continued existence of the fisher on the West Coast (Lewis and Zielinski 1996, Lewis and Stinson 1998).

C. Predation.

- Predation by a number of species is an important source of mortality for the fisher (Truex et al. 1998).

D. The inadequacy of existing regulatory mechanisms.

- In the Sierra Nevada, the Forest Service has failed to enact comprehensive and effective measures to protect the fisher and its habitat and proposed guidelines fail to adequately protect fisher habitat or to ensure recovery of the fisher in the central and northern Sierra Nevada.

- In the Pacific Northwest, the Northwest Forest Plan failed to enact substantial protection for the fisher and allows continued habitat loss.

- There are virtually no protections for fisher habitat on private or state lands, which occupy substantial portions of the species' present and historic range.

E. Other natural or manmade factors affecting its continued existence.

- Fire suppression, livestock grazing and logging have resulted in changes in forest structure and the accumulation of fuels, increasing danger of stand replacing fire and potential loss of fisher habitat in portions of the fisher's West Coast range.

- Because of small population size and isolation, remaining fisher populations on the West Coast may be in danger of extinction from inbreeding depression and demographic and environmental stochasticity, independent of any of a number of anthropogenic factors.

I. Introduction

The fisher (*Martes pennanti*) is a specialized forest carnivore that is associated with closed-canopy forests throughout its range and late-successional forests in the western United States (Dark 1997, Jones and Garton 1994, Powell 1993, Seglund 1995, Truex et al. 1998). A combination of logging, historic trapping and other factors led to a severe range contraction across the United States (Powell 1993, Powell and Zielinski 1994). In the eastern United States, the fisher recovered much of its range, as a result of strict trapping regulations, return of forest from abandoned farmlands and reintroductions. In the western United States, however, the fisher has not successfully re-inhabited the majority of its range, despite cessation of trapping (Aubry and Houston 1992, Zielinski et al. 1995a and 1997). The fisher is reduced to two native populations on the West Coast—one in northern California and another in the southern Sierra Nevada (Zielinski et al. 1995a and 1997)—and a reintroduced population in the southern Oregon Cascades (Aubry et al. 1996, Aubry and Lewis in litt.) All three populations are threatened by continued habitat loss to logging, development and other anthropogenic factors, and population isolation and demographic stochasticity (Lamberson et al. 2000, Truex et al. 1998). Reestablishing the fisher in a larger portion of its range, including the central and northern Sierra Nevada and portions of Oregon and Washington, may be necessary to ensure the long-term survival of the fisher on the West Coast. This is unlikely to occur without additional habitat protection provided by the Endangered Species Act. Thus, we are petitioning to list the fisher as an endangered species in its West Coast Range, which includes the Cascade Mountains and all areas west to the coast in Oregon and Washington, and the Sierra Nevada, North Coast and Klamath Mountains of California.

Two earlier petitions were submitted to list the fisher in the western United States (Beckwitt 1990, Carlton 1994). Beckwitt (1990) petitioned to list the fisher as endangered within the range currently being petitioned for, but as the subspecies *Martes pennanti pacifica*. The Fish and Wildlife Service determined that there was insufficient information to indicate *pacifica* is a valid subspecies, but did recognize the West Coast Range as a "distinct population segment" (90-day finding on a petition to list the Pacific fisher as endangered, Federal Register January 11, 1991).

They rejected the petition, however, because of lack of information, which was limited to only one study on habitat use in the western United States and little information on current distribution. Carlton (1994) petitioned to list the fisher in the entire western United States as endangered. This petition was ultimately rejected because Fish and Wildlife claimed the petitioner had failed to provide evidence indicating that the two remaining populations (Pacific States and northern Rocky Mountains) were distinct population segments listable under the Act (90-day finding for a petition to list the fisher in the western United States as threatened, Federal Register March 1, 1996). The finding, however, acknowledged that "available information indicates fishers have experienced declines in the past, and may be vulnerable to the removal and fragmentation of mature/old-growth habitat and incidental trapping pressure." Since both of these petitions were filed considerable information on fisher habitat use, current distribution and status has become available and is incorporated into this petition, demonstrating that the fisher in its West Coast range has experienced a significant diminution of habitat and range, is vulnerable to ongoing loss of habitat, and qualifies as a distinct population segment.

II. Natural History

A. Species description

Like other members of the weasel family (*Mustelidae*), the fisher has a long slender body with short legs. The fisher's head is triangular with a sharp, pronounced muzzle; eyes face forward and ears are large and rounded. Sexual dimorphism is pronounced with males weighing between 3.5 and 5.5 kg and females weighing between 2.0 and 2.5 kg (Powell 1993). Males range in length from 90 to 120 cm and females range from 75 to 95 cm (ibid.) The tail is long and bushy. Fishers are mostly dark brown in color. Their face, neck and shoulders are silver or light brown, contrasting with the tail, legs and rump, which are black. Their undersurface is uniformly brown, except for white or cream colored patches around the genitals and on the chest, which may be individually distinctive (Powell 1993). The fur ranges in length from 30 mm on the stomach and chest to 70 mm on the back (Powell 1993) Fishers have five toes with retractable but not sheathed claws. Their feet are large and plantigrade with four central pads and a pad on each toe. On the hindpaws, the central pads have circular patches of coarse hair that are associated with plantar glands. These glands produce a distinctive odor and are believed to be used for communication during reproduction (ibid.) Based on an examination of several skins, Grinell et al. (1937) noted that fishers from the Sierra Nevada had a "tendency" to be paler in color than fishers from other parts of the United States.

B. Taxonomy

A member of the family *Mustelidae*, the fisher is the largest member of the genus *Martes*, which includes the yellow-throated martens, true martens and fishers. Formerly included in the *Mustela*, the *Martes* are distinguished from this group by among other things an additional premolar in each jaw (see Anderson 1994). *Martes pennanti* (Erxleben) is the only extant species of the fisher. Goldman (1935) recognized three subspecies: *Martes pennanti pennanti* (eastern and central North America), *Martes pennanti columbiana* (Rocky Mountains), and *Martes pennanti pacifica* (West Coast North America). Conversely, both Grinnell et al. (1937) and Hagmeir (1959) examined specimens from across the range of the fisher without finding sufficient differences in morphology or pelage to support recognition of separate subspecies. Recent genetic analysis found patterns of population subdivision similar to the earlier described subspecies (Drew et al. in litt.) This observed variation was considered by Drew et al. to be insufficient to warrant recognition of subspecies, but sufficient to support recognition of distinct population segments. The West Coast population of the fisher was also recognized as a distinct population segment by USDI (1991) (see below). The present document recognizes the fisher in its West Coast range as a distinct population segment, but refers to it as *Martes pennanti*.

C. Diet

Fishers are an opportunistic predator with a diverse diet, including birds, porcupines, snowshoe hare, squirrels, mice, shrews, voles, insects, deer carrion, vegetation and fruit (Martin 1994, Powell 1993, Zielinski et al. 1999). Significantly, fishers in the southern Sierra Nevada and northern California utilize substantially different prey than fishers in other parts of the country (Zielinski et al. 1999). Throughout most of its range, snowshoe hare and porcupine are important components of the fisher's diet. The southern Sierra Nevada, however, is not within the range of the snowshoe hare and the porcupine occurs only at very low densities (Zielinski et al. 1999). Both are present in northern California, but not abundant. Although mammals were still the most frequent prey found in fisher scat from the southern Sierra, reptiles constituted a major prey item, occurring in 20.4% of all observed scat (Zielinski et al. 1999). Similarly, reptiles were found to be an important prey item for fishers in Northern California, but elsewhere in North America they constitute a very minor portion of the fisher's diet (<1%) (ibid.) Also unique to the southern Sierra Nevada and northern California, fishers were found to potentially feed on hypogeous fungi (false truffles) (Grenfell and Fasenfest 1979, Zielinski et al. 1999). Commenting on the unique diet of the fisher in the Sierra Nevada, Zielinski et al. (1999) conclude:

> "As a reputed habitat specialist, it may be adaptive for fishers to consider many of the other species with which they occur as potential foods. Perhaps this is the reason that fishers are capable of finding, capturing, and eating so many of the species that occur in, or near, late-seral conifer forests in the Sierra Nevada."

Zielinski et al. (1999) found slight variation in diet with season. Mammals, in particular deer carrion, were consumed most in winter, presumably when other prey were hibernating. Predictably, fruit were eaten more commonly in autumn and winter when they are typically available. No differences were found in diet between males and females, despite significant sexual dimorphism (ibid.)

D. Hunting behavior

Studies of fisher foraging behavior are limited to the eastern United States (Arthur and Krohn 1991, Powell 1993, Raine 1987). It is unknown to what extent these studies can be generalized to the West Coast, where different prey is available. Based on observations of fisher tracks in the winter, Powell (1993) determined that fishers in Michigan travel in straight lines to patches of high prey density and then forage in a "zig zag" pattern, changing direction frequently. These changes in direction are not random, but rather fishers appear to purposefully investigate potential prey hiding places, such as hollow logs, piles of forest litter or root-balls (Powell 1993, Raine 1987). This behavior was most often utilized by fishers when hunting snowshoe hare, but also when hunting other small mammals (Powell 1993). Fishers rarely chase prey for long distances, instead prey are caught directly after they are flushed. They do not pounce on small mammals with their paws like Canids. Prey are killed with a bite to the back of the neck or head. When killing hare, fishers sometimes wrap their body around them, holding on with their back legs (ibid.) Fishers do not need to be hungry to kill prey and will cache food. When feeding on deer carcasses, fishers often will find a resting den nearby and repeatedly return to the carcass to feed. Although fishers will dig holes in the snow to find prey, they exhibit far less subnivean activity than their close relative the American marten (Raine 1987). Fishers are known to occasionally forage in trees (Powell 1993, Raine 1987). Fishers are active both in the day and night with peak activity occurring near sunset and sunrise (Arthur and Krohn 1991, Powell 1993). Activity periods typically last from two-five hours (Powell 1993). Fishers hunt exclusively in forested habitats and generally avoid openings (ibid.)

E. Reproduction

The breeding season for the fisher begins in late February and lasts until mid-April. The testes of males begin to enlarge in early March and most males are producing sperm by mid-March (Frost et al. 1997, Powell 1993). Females come into estrus in early April three to nine days after parturition. Except during the breeding season, fishers are solitary animals. Beginning in March, males are more active and roam beyond the limits of their territories in search of females (Arthur and Krohn 1991, Powell 1993). As males cross territories, there is sometimes intra-specific aggression with several authors noting scars that they believed resulted from conflict with other male fishers (Leonard 1986, Powell 1993). Mate searching is likely assisted by marking of elevated objects, such as rocks and stumps, with urine, feces and musk, by both sexes (Leonard 1986, Powell 1993). Fishers are likely polygamous and may be polyandrous (Powell 1993). Courtship is often prolonged, lasting anywhere from one to seven hours, and involves tail flagging, chasing and vocalization, mostly on the part of the female (ibid.) If the female is not receptive, she will be aggressive towards the male. Ovulation may be stimulated by copulation (Frost et al. 1997). Implantation of the blastocyst is delayed approximately ten months and may correlate with increasing photoperiod (Powell 1993). Following implantation, gestation lasts for around 30 days. Parturition thus occurs nearly one year later and just prior to mating. Arthur and Krohn (1991) and Powell (1993) speculate that this system allows adults to breed in a time when it is energetically efficient, while still giving kits adequate time to develop before winter. Raised entirely by the female, kits are altricial with closed eyes and ears. By two weeks, light silver-gray hair covers the body and by 10 weeks kits wean (Powell 1993). The mother becomes increasingly active as kits grow in order to provide enough food (Arthur and Krohn 1991, Powell 1993). After about four months, the mother begins to show aggression towards kits and by one year kits will have developed their own home range (Powell 1993). Based on field observation and microsatellites genetic analysis, Aubry et al. (in litt.) found evidence suggesting that only juvenile male fishers disperse long distances, which if true, has a direct bearing on the rate at which the fisher may be able to colonize formally occupied areas within its historic range.

Fishers have a low annual reproductive capacity. Females breed at the end of their first year, but because of delayed implantation do not produce a litter until their second year. One year old males are capable of breeding, but some have questioned whether they are effective breeders (see Powell 1993). Litter sizes generally range from one to four, but can be as high as five or six in rare cases (Powell 1993). Not all fishers produce young every year. Truex et al. (1998) documented that of the females in their study area in the southern Sierra Nevada about 50-60% successfully gave birth to young. In their study area on the North Coast, however, 73% of females gave birth to young in 1995, but only 14% (one of seven) did so in 1996, indicating fisher reproductive rates may fluctuate widely.

F. Mortality

Powell (1993) estimated that 10 years may be the upper age limit for fishers. Predation and human caused death appear to be the most important sources of mortality (Powell and Zielinski 1994, Truex et al. 1998). Of 16 mortalities recorded by Truex et al. (1998), where they were able to speculate a cause of death, nine were suspected to be from predation and five were suspected to be human caused, including two vehicle collisions, two cases where the collar was cut, indicating poaching, and one fisher that became trapped in a water tank and died of exposure and/or starvation[1]. In Yosemite National Park, a total of four fishers were killed by automobiles between 1992 and 1998 (Chow personal communication). Where trapping is legal, it is a

[1] Folliard (1997) found the skeletons of eight fisher in a water tank in northwestern California, indicating that such "accidental traps" may be a substantial source of mortality for the fisher.

significant source of mortality. Krohn et al. (1994), for example, found that over a five year period trapping was responsible for 94% of all mortality for a population of the fisher in Maine.

G. Habitat requirements

Studies on the habitat use of fishers in the western U.S. demonstrate that it is associated with mature and late successional forests (Aubry and Houston 1992, Buck et al. 1994, Dark 1997, Jones and Garton 1994, Powell and Zielinski 1994, Seglund 1995, Truex et al. 1998, Zielinski 1999). In particular, fishers are generally found in stands with high canopy closure, large trees and snags, large woody debris, large hardwoods, multiple canopy layers and few openings. Based on an extensive review of existing studies, Buskirk and Powell (1994) concluded:

> "Do American martens and fishers require particular forest types—for example, old-growth conifers—for survival? We think they do. Ecological dependency has been defined in terms of viability of populations, and distributional losses of marten and fisher populations in response to habitat change provide evidence that populations require the habitats that individuals, especially reproductive adults, behaviorally prefer."

The following paragraphs summarize results of existing studies of fisher habitat use while resting, denning, and foraging in the western United States with particular emphasis on the West Coast.

1. Resting and denning habitat requirements

Numerous studies have documented that fishers in the western United States utilize stands with late-successional forest characteristics, such as large trees and snags, coarse woody-debris, high canopy closure and multiple-canopy layers, for resting and denning (Aubry et al. 1996, Carroll et al. 1999, Dark 1997, Powell and Zielinski 1994, Seglund 1995, Truex et al. 1998, Zielinski 1999). For example, Truex et al. (1998) documented both high mean canopy closure and high mean diameter at breast height (dbh) of the four largest trees in stands surrounding fisher rest sites on three study areas in California (Table 1).

Table 1. Attributes of stands surrounding fisher rest sites as documented by Truex et al. (1998).

Study site/stand	**North Coast**	**Southern**	**Eastern**

attribute		Sierra	Klamath
Mean canopy closure	93.9%	92.5%	88.2%
Mean DBH of the four largest trees (cm)	118.3	89.6	46.2

Further, a preliminary analysis demonstrates that in both northern California and the southern Sierra, maximum DBH and percent canopy cover are two of the most significant variables explaining differences between rest and random sites (Zielinski 1999). Similarly, Dark (1997) found that stands surrounding fisher rest sites have greater amounts of 50-75% canopy cover, fewer disjunct core areas and more Douglas-fir than areas where fishers were not detected, and Seglund (1995) found that the fisher used rest sites with greater basal area per m^2, a higher percentage of dead and down woody debris, a greater average DBH of the four largest trees on the plot, and a greater number of vegetation layers (multiple canopy layers) than sites where fishers were not detected[2]. Most of these characteristics are typical of late-successional forests.

One reason the fisher may be associated with late-successional forest conditions when resting and denning is that these stands contain the large trees, snags and logs typically used by fishers for rest or den sites (Powell and Zielinski 1994, Truex et al. 1998). Fishers generally rest in or on live trees, snags, or logs with cavities, broken tops, large limbs, mistletoe brooms, or platforms made by raptors or squirrels. These characteristics are usually only found on large, old trees (ibid.) Truex et al. (1998), for example, found that in three separate study areas, including the North Coast, Eastern Klamath and southern Sierra Nevada of California, fishers most frequently rested in live trees, followed in order of importance by snags, platforms and logs. Rock piles, subnivean sites and holes in the ground were utilized less frequently. Douglas fir was by far the most common species used for resting in both northern California sites, whereas oaks and true firs were most commonly used in the southern Sierra. The average diameter at breast height (DBH) of trees and snags used by fishers for resting on three California study areas was 105.8 cm for conifers and 87.1 cm for hardwoods on the North Coast, 111.7 cm for conifers and 65 cm for hardwoods in the southern Sierra Nevada, and 77.2 cm for conifers and 49.3 cm for hardwoods in the eastern Klamath (Truex et al. 1998). Approximately 80% of all logs used as

[2] Seglund (1995) and Dark (1997) both conducted research on the eastern Klamath study area and their data was incorporated into Truex et al. (1998)

rest sites by fishers were over 76 cm diameter (ibid.) Other studies from the West Coast have found similar results (Table 2). Significantly, appropriate rest sites must be widely distributed throughout home ranges of fishers because they are typically only used for one rest or sleep (Powell and Zielinski 1994, Truex et al. 1998).

Table 2. Average diameter of trees used for resting by fishers in several studies.

Study author	**Location**	**Average diameter of trees used for resting**
Truex et al. 1998	North Coast, Eastern Klamath and southern Sierra Nevada California	77.2-111.7 cm for conifers; 49.3-87.1 cm for hardwoods
Buck et al. 1983	northern California	114.3 cm
Higley 1998	Hoopa Valley Indian Reservation, northern California	110 cm for conifers; 74.6 cm for live hardwoods.

Trees used for natal and maternal dens were also large. Of 19 tree dens documented by Truex et al. (1998) across the three study areas, the average DBH was 114.8 cm for conifers and 62.5 cm for hardwoods (*Quercus ssp.*). Commenting on the significance of use of large trees and snags for resting and denning to the conservation of the fisher and its habitat, Powell and Zielinski (1994) concluded:

> "Large physical structures (live trees, snags, and logs) are the most frequent fisher rest sites, and these structures occur most commonly in late-successional forests. Until it is understood how these structures are used and can be managed outside their natural ecological context, the maintenance of late-successional forests will be important for the conservation of fishers."

2. Foraging and general habitat requirements

In general, foraging habitat requirements are more difficult to study because it is harder to locate moving animals and because once they are located it is difficult to determine whether or not they are simply traveling through an area or actively hunting. Despite these limitations, several studies have characterized presumed foraging habitat, which similar to resting habitat, is often typified by characteristics associated with mature and late-successional forests (Dark 1997, Jones and Garton 1994, Zielinski 1999). Zielinski (1999) documented that fishers on the North Coast of California foraged (as measured by visits to track plate stations) in stands with greater basal area, a wider range of tree sizes (based on greater dbh standard deviation; this factor suggests presence of multiple canopy layers) and significantly higher canopy closure (average of 91.7% for sites with detections compared to 79.0% sites without detections) than stands where fishers were not found to forage and that fishers in the southern Sierra foraged in stands with higher canopy closure of both trees and shrubs than stands where fishers did not forage. Dark (1997) found no differences between fisher resting locations and track-plate locations, potentially indicating that fishers use late-successional habitats for all activities, including resting, traveling and foraging.

Conversely, Klug (1997) found no difference in age between stands where fishers were detected at track plate stations and where fishers were not detected and thus found no relationship between fishers and late-successional forests in his study on private timber lands in coastal, northern California. However, Klug noted that there was very little old-growth in his study area (<2%) and that track plate surveys are unable to detect whether or not fishers are using the area incidentally or regularly. Powell and Zielinski (1994) concluded:

> "While some recent work in northern California indicates that fishers are detected in second-growth forests and in areas with sparse overhead canopy, it is not known whether these habitats are used transiently or are the basis of stable home ranges. It is unlikely that early and mid-successional forests, especially those that have resulted from timber harvest will provide the same prey resources, rest sites and den sites as more mature forests."

A number of studies have shown that the fisher avoids areas with little forest cover or significant human disturbance and conversely prefer large areas of contiguous interior forest (Dark 1997, Jones and Garton 1994, Powell 1993, Rosenberg and Raphael 1986, Seglund 1995). For example, the Penobscot River in Maine delayed expansion of the fisher from the west to the east side of the river by almost a decade (Coulter 1966, Powell 1993). Seglund (1995) found that a majority of fisher rest sites (83%) were further than 100 m from human disturbance and Dark

(1997) found that fishers used and rested in areas with less habitat fragmentation and less human activity. Rosenberg and Raphael (1986) found that presence of fishers was highly correlated with stand insularity and that they "decreased sharply in frequency of occurrence in stands <100 ha." Lastly, Freel (1991) determined, based on a review of studies, that high quality habitat was characterized by a road density less than one half mile to every square mile. Fishers probably avoid open areas because they are more vulnerable to potential predators without forest cover and because in winter open areas have deeper snow, which is believed to make travel inefficient (Krohn et al. 1997, Powell 1993). Conversely, fishers are probably associated with habitat with contiguous forest cover because this is where they find sufficient available prey and suitable resting and denning sites (Powell 1993, Powell and Zielinski 1994).

Several studies have shown that fishers are associated with riparian areas (Aubry and Houston 1992, Dark 1997, Seglund 1995, Zielinski 1999). For example, Aubry and Houston (1992) noted that many of the past sightings of the fisher in Washington State were in riparian areas or wetlands. This is probably because riparian forests are in some cases protected from logging and are generally more productive, thus having the dense canopy closure, large trees and general structural complexity associated with fisher habitat (Dark 1997). Fishers have also been shown to be associated with habitat with more and larger hardwoods and more shrub cover (Carroll et al. 1999, Dark 1997, Klug 1997, Seglund 1995, Zielinski 1999).

In sum, fishers in the western United States are habitat specialists associated with forests with late-successional characteristics, including an abundance of large trees, snags and logs (>100 cm), multiple canopy layers, high canopy closure, and few openings (Dark 1997, Freel 1991, Powell and Zielinski 1994, Seglund 1995, Truex et al. 1998). In combination with their avoidance of human disturbance, this association makes the fisher highly sensitive to anthropogenic habitat loss and fragmentation related to logging, development and other factors. Based on a survey of fisher distribution in Washington and a review of other studies, Aubry and Houston (1992) concluded:

> "We predict that available habitat for fishers would be enhanced by minimizing forest fragmentation, maintaining high forest-floor structural diversity, preserving snags and live trees with dead tops, and protecting swamps and other forested wetlands."

Indeed, elimination of late-successional forest characteristics from large portions of the Sierra Nevada and Pacific Northwest (Aubry and Houston 1992, McKelvey and Johnson 1992, Franklin and Fite-Kauffman 1996, Morrison et al. 1991) has probably contributed to the significant diminution of the fisher's historic range on the West Coast (Lewis and Stinson 1998).

3. Home range size

Fishers have large home ranges, with those of males considerably larger than those of females (Buck et al. 1983, Kelly 1977, Truex et al. 1998). Male home ranges in the southern Sierra, based on minimum convex polygons, average 6808 acres compared to 1246 acres for females (Zielinski et al. 1997b). Similarly, average home ranges in northern California were 6228 acres for males and 1538 acres for females (Zielinski et al. 1995b). Home range size likely varies with quality of habitat. Truex et al. (1998) compared fisher home range sizes in three study areas and found that they were largest in the eastern Klamath where habitat quality was generally considered poor. They concluded:

> "Individuals are expected to use larger areas in poorer quality habitat and therefore to exist at lower densities. Both of these indices support the relatively lower quality of habitat on the eastern Klamath study area than the North Coast or Southern Sierra Studies."

Based on a review of eight studies of fisher home range size, Freel (1991) determined that to support a reproductive unit of fishers, including the home ranges of one male and two females, would require 6,000 acres in high capability habitat with 70-80% in mature, closed conifer forest, 9800 acres in moderate capability habitat with 61-80% in mature, closed conifer forest, and 11,300 acres in low capability habitat with 50-60% in mature, closed conifer forest. Lastly, Carroll et al. (1999) compared fisher locations with habitat variables at the scale of the stand, landscape and region and found that habitat variables at landscape and regional scales predicted fisher distribution as well as a model incorporating fine-scale habitat attributes, potentially indicating that the fisher may be selecting habitat at the home range scale or above. At the landscape scale, fisher distribution was strongly associated with landscapes with high levels of tree canopy cover (ibid.)

H. Historic and Current Distribution

1. California

In California, the fisher historically ranged throughout the Sierra Nevada from Greenhorn Mountain in northern Kern County to the southern Cascades at Mount Shasta. From there, they ranged west into the North Coast Ranges and Klamath Mountains from Lake and Marin Counties north to the State line (Figure 1)(Grinnell et al. 1937). In the Sierra Nevada, the fisher occurs from roughly 600-2,600 m with occasional sightings up to 3,000 m (Grinell et al. 1937, Zielinski et al. 1997a). In northern California, fishers are occasionally seen at sea level, but more commonly occur from 600-1,700 m (ibid.) The upper elevational limit of the fisher's range generally corresponds with those areas that receive significant winter snowfall, where it is believed fishers are not able to travel efficiently (Krohn et al. 1997). Throughout California, fishers occur in mixed conifer, Douglas-fir and ponderosa pine forest types (Zielinski et al. 1997a, Zielinski et al. 2000). Based on systematic surveys conducted from 1996-1999 in forested areas of northwestern California, the Sierra Nevada and southern Cascades, Zielinski et al. (2000) determined that of all fisher detections roughly 45% were in the pine type, 18% were in the mixed conifer type, 11% were in the true fir type and 25% were in the Douglas-fir type, according to CWHR habitat types. In addition, Beyer and Golightly (1996) detected fishers at track plate stations in the coast redwood zone, but detection ratios were lower than in other habitats. Fishers, however, were commonly detected in mixed redwood/Douglas fir forest and coastal forests comprised of sitka spruce, red alder and occasional coast redwood (Beyer and Golightly 1996).

The fisher has declined to roughly 50% of its historic range in California (Zielinski et al. 1997a). In particular, Zielinski et al. (1997b and 2000) failed to detect fishers north of Yosemite Park in an extensive survey using camera and track plate surveys, suggesting that the fisher may be extirpated or occur at very low densities in the central and northern Sierra Nevada (Figure 2). This has effectively isolated fishers in the southern Sierra Nevada from fishers in northern California by a distance of roughly 420 km (Lamberson et al. 2000, Truex et al. 1998), which is greater than the observed maximum dispersal distance of the fisher (Arthur et al. 1993, York 1996). Truex et al. (1998) conclude that "for all intents and purposes the southern Sierra is a

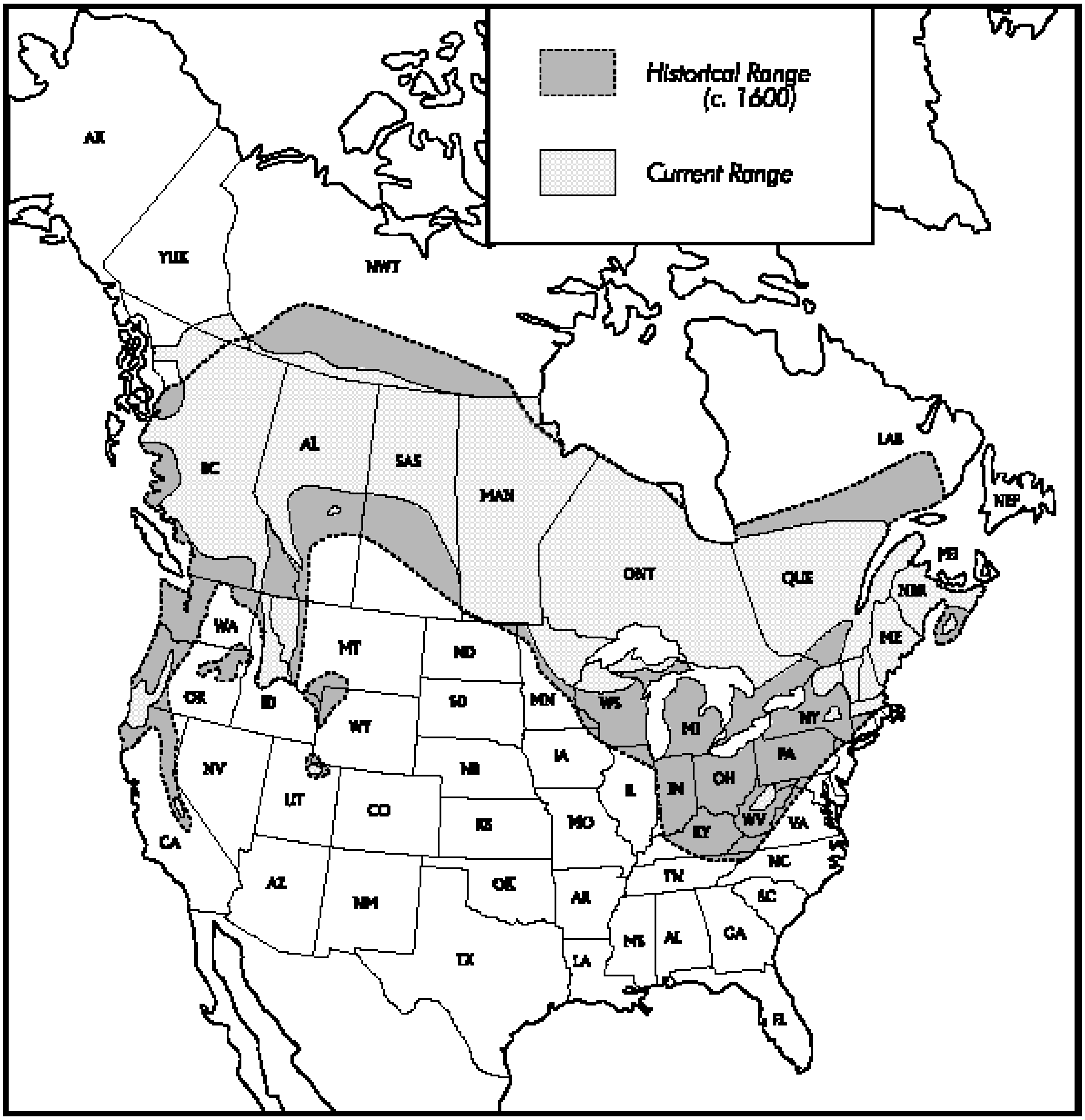

Figure 1. Map of the fisher's historic and current range in North America from Lewis and Stinson (1998).

demographically closed population." Loss of the fisher from the northern Sierra Nevada was likely caused by a combination of factors, including over a century of logging with concurrent road building, rapid population growth, development and trapping prior to 1946 (Duane 1996a, Lamberson et al. 2000, McKelvey and Johnson 1992). In part because of its isolation, the southern Sierra Nevada population is believed to be at substantial risk of extinction (Lamberson et al. 2000, Truex et al. 1998). In addition, fishers in northern California are almost certainly isolated from the larger continental population because of loss of the fisher from large portions of Oregon and Washington. As a result, fishers are likely vulnerable to extirpation on the West Coast (Gould 1987, Beyer and Golightly 1996).

2. Oregon

Information on the historic distribution of the fisher in Oregon is limited. Only three fisher specimens are contained in museum collections (Verts and Carraway 1998). A map in Verts and Carraway (1998) show the fisher in Oregon occurring throughout the Cascade, Klamath-Siskiyou, Blue and Wallowa Mountains, but absent from northwestern Oregon. Lewis and Stinson (1998), however, included northwestern Oregon in their map (Figure 1). Furthermore, Aubry and Houston (1992) noted that most fisher records for Washington occurred in the western hemlock and sitka spruce forest zones. Given that these forest zones occupy large portions of northwestern Oregon (Franklin and Dyrness 1988), it is likely that the fisher occurred in this part of the state. This petition covers fishers only in their West Coast Range and not the Rocky Mountains. Because fisher in the Wallowa and Blue Mountains were historically probably more connected with fisher in the Rocky Mountains (Aubry personal communication), this petition does not cover these portions of Oregon or Washington.

Based on extensive camera and track-plate surveys conducted throughout forested regions of Oregon, the fisher is currently limited to an introduced population in the southern Cascades in the upper Rogue River drainage west of Crater Lake National Park and a small number of individuals in the Siskiyou Mountains of southwestern Oregon near the California border, which are probably a northern extension of the northern California population (Aubry et al. 1996, Aubry and Lewis in litt.) Thus, current information indicates that the fisher is severely reduced in Oregon.

3. Washington

The fisher historically occurred both east and west of the Cascade Crest in Washington (Figure 1)(Aubry and Houston 1992, Scheffer 1938, Suckley and Cooper 1860). Lewis and Stinson (1998) concluded that:

> "Based on habitat, the historic range of fishers in Washington probably included all the wet and mesic forest habitats at low to mid-elevations. The distribution of trapping reports and fisher specimens collected in Washington confirms that fishers occurred throughout the Cascades, Olympic Peninsula, and probably southwestern and northeastern Washington."

Aubry and Houston (1992) compared current and historical records of fishers in Washington to determine their distribution in relation to major vegetation and elevation zones. In total, they found 88 reliable records, dating from 1955-1991. West of the Cascades, most fisher records were from below 1000 m (87%) and all were below 1800 m. Conversely, fishers east of the Cascade Crest were found from 600 to 2,200 m. Similar to elsewhere in the range, the upper elevation limit is probably determined by snow depth (Krohn et al. 1997). The majority of fisher locations west of the Cascades were in the western hemlock forest zone (54%), followed by the Pacific silver fir zone (26%) and the sitka spruce zone (20%). East of the crest, fishers were found primarily in the subalpine fir zone (53%) and grand fir/Douglas-fir zone (37%) with a small number in the timberline/alpine zone (10%) (Aubry and Houston 1992).

Based on a lack of recent sightings or trapping reports, the fisher has been apparently extirpated or reduced to scattered individuals in Washington (Aubry and Houston 1992, Lewis and Stinson 1998). Despite extensive surveys, there have been only two verifiable records in western Washington since 1969, both of which were near facilities that maintain fishers in captivity and reported that fishers have on occasion escaped (Northwest Trek in Eatonville, WA and Dale Peterson's Game Farm in Graham, WA)(Aubry personal communication, Aubry and Houston 1992). Lewis and Stinson (1998) reported that:

> "Extensive surveys by WDFW and the U.S. Forest Service have failed to find a fisher population, or even confirm the presence of a fisher in areas where reports are concentrated. Infrequent sightings and incidental captures indicate that a small number may remain that have gone undetected."

In sum, the fisher has been extirpated or reduced to scattered individuals in large portions of Oregon, Washington and California.

I. The West Coast population of the fisher qualifies as a "distinct population segment"

To be considered for listing as an endangered species, the West Coast population of the fisher must qualify as a "distinct population segment" (DPS). The U.S. Fish and Wildlife Service (Fish and Wildlife) will consider a population a DPS if it is "discrete" in "relation to the remainder of the species to which it belongs" ***and*** it is "significant" to the species to which it belongs. According to Fish and Wildlife's current policy regarding recognition of distinct vertebrate populations (Federal Register V. 61, No. 26, February 7, 1996), a species is considered discrete if it is "markedly separated from other populations" because of "physical, physiological, ecological, or behavioral factors;" ***or*** it is "delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4 (a) (1) (D)." The policy further clarifies that a population need not have "absolute reproductive isolation" to be recognized as discrete. A population is considered significant based on, but not limited to, the following factors: 1) "persistence of the discrete population in an unusual or unique ecological setting;" 2) "loss of the discrete population would result in a significant gap in range;" 3) the population "represents the only surviving natural occurrence of an otherwise widespread population that was introduced;" or 4) the population "differs markedly in its genetic characteristics" (Federal Register V. 61, No. 26, February 7, 1996).

1. Discreteness

Existing information strongly indicates that remaining native populations of the fisher on the West Coast are geographically, reproductively and genetically isolated from fisher populations in the Rocky Mountains and British Columbia and are thus discrete (Aubry and Lewis in litt., Lewis and Stinson 1998). Fishers have a strong aversion to areas lacking in forest cover (e.g. Powell 1993). As a result, numerous geographical barriers block fisher dispersal from the Pacific States to the Rocky Mountains and British Columbia, including major rivers, such as the Columbia and Snake, non-forested areas, such as the Okanogan Valley, and major highways and urban areas. Indeed, Fish and Wildlife in response to an earlier petition to list the fisher in its

West Coast range (Beckwitt 1990) has already determined that this population is discrete, concluding:

> "any genetic exchange would have to occur in central to northern British Columbia. The large geographic distance from the Pacific States to central British Columbia, then to Idaho, in conjunction with the ecological barrier presented by the relatively open Okanogan Valley, led Jones to conclude that genetic exchange between the Rocky Mountain and Pacific fishers is 'extremely low.' Thus, it is our determination that, while genetic information is insufficient to determine whether subspecies status is appropriate, that the Pacific fisher represents a distinct population that interbreeds. The Pacific fisher is therefore a 'species' within the meaning of the Act" (Federal Register 1159, January 11, 1991).

Furthermore, this determination was made before it was known that the fisher has been largely eliminated from substantial portions of Oregon, Washington and southern British Columbia, which has made genetic exchange through British Columbia even less likely (Aubry and Lewis in litt., Government of British Columbia, Ministry of Environment, Land and Parks, Conservation Data Centre Blue List, Lewis and Stinson 1998).

Extensive survey and sighting information strongly indicates that the fisher has been extirpated from extensive portions of Oregon and Washington (Aubry and Houston 1992, Aubry et al. 1996, Lewis and Stinson 1998), isolating populations in northwestern California, the southern Sierra Nevada and southern Oregon from those in central British Columbia and the Rocky Mountains by at least 800-1,000 km. Although evidence indicates that scattered individual fishers may occur in Washington, it is unlikely that these individuals could facilitate genetic exchange between remaining fisher populations in California and Oregon and the larger continental population. If in the rare chance there were some genetic exchange, however, this would not preclude the fisher on the West Coast from being considered discrete because Fish and Wildlife's policy does not require "absolute reproductive isolation" (FR V. 61, No. 26, February 7, 1996).

Further evidence that fisher populations on the West Coast are isolated is provided by evidence indicating that remaining fisher populations in Oregon are discrete from each other. Aubry et al. (in litt.) determined, based on microsatellites analyses, that there has been no interbreeding between fishers in the northern Siskiyou Mountains in Oregon and fishers in the southern Cascade Range in Oregon and concluded:

> "the strong allelic differences we found between Siskiyou and Cascade fisher populations in Oregon provides empirical evidence that fishers translocated into the southern Oregon Cascade Range have remained genetically isolated from those occurring in the northern Siskiyou Mountains. The northern Siskiyou Mountains are well within the dispersal capability of juvenile fisher populations in our study populations; thus physical or ecological barriers must be operating to maintain the genetic isolation of our study population. These populations are separated by a 4-lane interstate highway, urban and agricultural in and around the city of Medford, and extensive areas of open grassland and oak savannah in the interior Rogue River Valley (Franklin and Dyrness 1973). Our results provide strong evidence that in southwestern Oregon, one or more of these barriers prevents genetic interchange between fisher populations in the Cascade Range and those in the Siskiyou Mountains."

If fishers are not able to interbreed across a relatively short distance because of geographic barriers, it is highly unlikely that they are interbreeding across a large area with numerous similar barriers.

Fisher populations on the West Coast can also be considered discrete from fisher populations in Canada because of the International boundary between the United States and Canada (FR V. 61, No. 26, February 7, 1996). Fish and Wildlife recently determined that the lynx (*Lynx canadensis*) in the United States is discrete from lynx in Canada because of the international boundary, stating:

> "Canada has no overarching forest practices legislation, such as the United States National Forest Management Act, governing management of national lands and/or

> providing for consideration of wildlife habitat requirements. Additionally, in Canada, lynx harvest regulations, such as length of season and quotas, vary, being regulated by individual provinces or, in some cases, individual trapping districts. Therefore, we conclude that the contiguous United States population of the lynx is discrete based on the international boundary between Canada and the contiguous United States due to differences in management of lynx and lynx habitat."

This statement applies equally to the fisher because, like the lynx, it is a furbearer strongly associated with forest environments and is still harvested in Canada.

In British Columbia (B.C.), trapping is for the most part self-regulated by trappers, who are permitted specific traplines for life (Mike Badry personal communication). In southern B.C., trapping for the fisher is closed because of its scarcity. Trapping for the marten, however, is considerable and incidental capture of fishers is a problem (ibid.) Trapping for the fisher in the northern part of the Province is open. Monitoring of either lawful or incidental capture of fishers is in the majority of cases carried out by the trappers themselves.

Canada does not have an Endangered Species Act, but the fisher is on British Columbia's "Blue List" (Government of British Columbia, Ministry of Environment, Land and Parks, Conservation Data Centre Blue List). This listing, however, only identifies the fisher as vulnerable and does not confer any protection to the fisher or its habitat.

Under British Columbia's Forest Practices Code, the fisher is listed as an "identified wildlife species." Unlike the National Forest Management Act in the U.S., however, much of British Columbia's forest practices code is not mandatory and most forest management decisions occur at the district level. Indeed, the management prescriptions for fisher under the code specifically state: "the following recommendations are not mandatory, are not to be inferred as government direction and are not intended to have application across the entire planning area" (Ministry of Forests 2000)

In sum, British Columbia lacks overarching management of fisher habitat and harvest of fishers similar to protection provided by either the National Forest Management Act or the Endangered Species Act. Although trapping of the fisher has been closed in southern British Columbia, extensive unregulated incidental capture occurs during trapping of the marten and trapping of fishers continues in the northern portion of the province. Similarly, the fisher's position on the Province's Blue List or classification as an "identified wildlife species" under B.C.'s forest practices code conveys little protection to the fisher or its habitat. Thus, because of differences in management between the United States and Canada, fishers on the West Coast can be considered discrete from fishers in Canada based on the international boundary.

In response to a petition to list the fisher in the western United States (Carlton 1994), Fish and Wildlife argued that the international boundary can only be used to list a DPS when the entire range of the species in the United States requires listing under the Act. However, Fish and Wildlife's policy (Federal Register V. 61, No. 26, February 7, 1996) did not specify that a DPS delimited by an international boundary must include the entire United States population (FR V. 61, No. 26, February 7, 1996) and Fish and Wildlife has considered and listed other distinct population segments of species delimited by an international boundary without listing the species in its entire United States range. For example, Fish and Wildlife considered the cactus ferruginous pygmy owl (*Glaucidium brasilianum cactorum*) in Arizona discrete from populations in Mexico based on the international boundary and listed it as an endangered DPS, even though there is another population of the owl in Texas (Federal Register March 10, 1997, V. 62, No. 46).

Thus, the West Coast population of the fisher should be considered discrete both because it is geographically, reproductively and genetically isolated from populations in Canada and the Rocky Mountains and because it is separated from these populations by the international boundary beyond which there is inadequate protection for the fisher and its habitat.

2. Significance

The West Coast population of the fisher meets all of the four factors identified by Fish and Wildlife's policy for determining that a population is significant (Federal Register V. 61, No. 26, February 7, 1996). The two remaining native populations in California are the only extant native populations in the western United States (Truex et al. 1998), occur in an unusual ecological setting, have unique behavioral adaptations and are genetically distinct. In addition, loss of the fisher on the West Coast would represent loss of the species from a significant portion of its range.

As the only surviving native populations in the western United States, the two remaining fisher populations on the West Coast may have developed local adaptations, allowing them to survive in a substantially different environment than found in the rest of the fisher's range in North America. Thus, loss of these populations may substantially compromise future efforts to restore the fisher to a larger portion of their historic range on the West Coast.

Fishers on the West Coast occur in a region with drastically different climate, topography and vegetation than the bulk of the fisher's range. The climate of the West Coast is characterized by mild, wet winters and warm dry summers (Bailey 1995). In contrast, the climate of the fisher's range in the Lake States and Northeast is characterized by cold winters and warm, wet summers and the climate in the Rocky Mountains is characterized by cold winters and dry summers.

Furthermore, fishers on the West Coast occur primarily in areas with steep, mountainous terrain, while in the Lake States, Northeast and Canada the terrain is either level or subdued, glaciated mountains (ibid.) Truex et al. (1998), for example, noted that fishers in California occur in an area where "physical conditions change rapidly over both latitudinal and elevational gradients," and concluded that:

> "These conditions are quite different from the core of its range in the forests of Canada and northern United States, where topographic variation is often slight and forests are relatively homogenous over large regions."

Forests of the West Coast are also different because they lack the substantial broadleaf component found in forests of the Lake States and Northeast, where American beech, sugar maple and other broadleaf species are common. Powell and Zielinski (1994) concluded:

> "Differences in forest habitats between the Pacific States, the Rocky Mountains, and the forest of the Upper Midwest and Northeast are profound enough to prevent simplistic extrapolations about fisher habitat relationships."

Reflecting these differences, the various portions of the fisher's range are classified in different "ecoregions" (Bailey 1995). Such regions were classified by the Forest Service as an "essential tool" for ecosystem management that recognized ecological units with similar climate, physiography, water, soils, air, hydrology, and vegetation (McNab and Avers 1995). Fisher habitat in California is found in the "Mediterranean Division and Sierran Steppe—Mixed Forest—Coniferous Forest—Alpine Meadow Province." In Oregon and Washington it is found in the "Marine Division and Cascade Mixed Forest—Coniferous Forest—Alpine Meadow Province" (ibid.) The climate, topography and many of the major forest species are relatively similar between the Mediterranean and Marine Divisions, although the Marine Division receives substantially more precipitation. In contrast, fisher habitat in the Lake States and Northeast is found in the "Warm Continental Division, and Laurentian Mixed Forest and Adirondack-New England Mixed Forest--Coniferous Forest--Alpine Meadow Provinces." In the Rocky Mountains, fisher habitat occurs in the "Temperate Steppe Division" and "Northern Rocky Mountain Forest-Steppe--Coniferous Forest--Alpine Meadow Province" (Bailey 1995).

Fish and Wildlife has listed other species because of differences in climate and vegetation. For example, in listing the Peninsular bighorn sheep as a distinct population segment under the ESA, the Fish and Wildlife Service noted that the sheep occurs "in an area that has marked climatic and vegetational differences as compared to most other areas occupied by bighorn sheep," which "suggests unique behavioral and/or physiological adaptions." 63 Fed. Reg. 13134, 13136 (March 18, 1998). As demonstrated above, the same considerations apply to the West Coast population of the Pacific fisher and indicate that the population should be considered "significant" under the ESA.

Fishers on the West Coast have also been found to be genetically distinct from fishers in the rest of North America and in particular fishers in California were found to have reduced genetic diversity compared to other populations in North America (Drew et al. in litt.) Drew et al. (in litt.) believed this variation was sufficient to warrant recognition of fishers on the West Coast as a distinct population segment. Genetic distinctiveness is also supported by microsatellites analyses which show that reintroduced fishers in the southern Oregon Cascades are genetically distinct from fishers in the northern Siskiyou Mountains of Oregon, which appear to represent the northern extension of populations in northwestern California (Aubry et al. in litt.)

Finally, loss of the fisher from the West Coast would result in a significant diminution of the fisher's range, particularly in the western United States where the West Coast constitutes more than 50% of the fisher's historic range. Overall, the West Coast comprises roughly 10-20% of the entire United States range and harbors two of eight current contiguous populations (Lewis and Stinson 1998). That loss of the fisher from the West Coast counts as a significant diminution of the fisher's range is supported by other Fish and Wildlife findings. In listing five distinct population segments of the bull trout, for example, Fish and Wildlife found that loss of any of the five "would significantly reduce the overall range of the taxon." 64 Fed. Reg. 58909 (November 1, 1999). Loss of the West Coast population of the fisher would have an equal, if not greater, negative impact on the species' overall range. Similarly, in listing the Sierra Nevada population of the bighorn sheep, the Service found that the loss of the population "would result in the total extirpation of bighorn sheep from the Sierra Nevada," leading to "a significant gap in bighorn sheep population distribution." 65 Fed. Reg. 20, 22 (January 3, 2000). The identical argument applies to the fisher. Finally, in proposing to list the population of the lynx in the United States as a DPS, the Fish and Wildlife Service noted that "Canada lynx in the contiguous United States might be considered biologically and/or ecologically significant simply because they represent the southern extent of the species' range," 62 Fed. Reg. 28653, 28654 (May 27, 1997), and in listing the Santa Barbara County California tiger salamander the Service similarly concluded that the population "is also significant in that it constitutes the only population of California tiger salamanders west of the outer Coast ranges, and it is the southernmost population of the species." 65 Fed. Reg. 57241, 57244 (September 21, 2000). The same argument applies here, because loss of the West Coast population of the fisher would mean loss of the southernmost and westernmost population of the fisher in North America.

In conclusion, because the West Coast population of the fisher is discrete from the rest of North America and significant based on several factors, it qualifies as a distinct population segment.

III. Population Status

A. California

Three primary studies of fisher demography in California have been conducted, including one of the southern Sierra Nevada population and two of the northern California population. These studies utilized radio-collared fishers to study reproduction, survival and habitat use. Although these studies have only begun to gain insight into fisher population ecology, preliminary estimates of mortality indicate fisher populations, particularly in the southern Sierra, may be at significant risk of extinction.

1. Southern Sierra Nevada population

Several factors place the fisher population in the southern Sierra at risk of extinction, including isolation, small population size, demographic and environmental stochasticity, low reproductive capacity, and ongoing habitat loss (Lamberson et al. 2000). As noted above, this population is isolated from others by approximately 420 km and as a result, there is a low probability that it could be rescued through migration of individuals from other populations were it to decline because of demographic stochasticity, catastrophes or other factors. Truex et al. (1998) conclude:

> "Recolonization of the central and northern Sierra Nevada may be the only way to prevent fisher extinction in the isolated southern Sierra Nevada population."

Further, without immigration the southern Sierra population may be susceptible to inbreeding depression. Indeed, genetic studies using mitochondrial and nuclear DNA sequencing indicate "very low" genetic variability in southern Sierra Nevada fishers (see Lamberson et al. 2000).

In addition to being isolated, the southern Sierra Nevada population is small, including probably no less than 100 individuals, but almost certainly fewer than 500 (Lamberson et al. 2000). Generally, a population size of 500 breeding pairs composed of 2,000-3,000 individuals is considered the absolute minimum to maintain population viability (Lande and Barrowclough 1987, Lande 1993). Populations well below this minimum, like the southern Sierra fisher population, are at risk of extinction solely from demographic and environmental stochasticity, independent of deterministic factors, such as anthropogenic habitat loss. Random fluctuations in gender ratio, fecundity or mortality; and/or droughts, cold weather, heavy snow years and other temporal environmental changes can lead to declines that in small populations result in rapid extinction. These factors present very real threats to the long-term survival of the isolated southern Sierra population (Lamberson et al. 2000). Catastrophes, such as stand-replacing fire or severe storms, magnify risk of extinction further (Lande 1993, Schaffer 1987).

Although little is known about fisher demography, what is known is cause for concern. Fishers have very low reproductive capacity. After two years of age they generally produce only one-four kits per year and only a portion of all females breed (Powell 1993, Lamberson et al. 2000, Truex et al. 1998). Low fecundity means that fisher populations are slow to recover from population declines, further increasing risk of extinction. Of even greater concern, Truex et al. (1998) documented that adult female fishers in the southern Sierra Nevada have a very low annual survival rate, which from 1994-1996 was 61.2%[3]. Of all demographic parameters, female survival has been shown to be the most important single factor determining fisher population stability (Lamberson et al. 2000, Truex et al. 1998). If high female mortality continues, it is unlikely that the fisher will persist in the southern Sierra Nevada and indeed Truex et al. (1998) conclude "high annual mortality rates raise concerns about the long-term viability of this population."

Lamberson et al. (2000) used a deterministic, Leslie stage-based matrix model to gauge risk of extinction for the southern Sierra Nevada population of the fisher and found that the population has a very high likelihood of extinction given reasonable assumptions with respect to demographic parameters. They concluded:

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[3] Using the Kaplan-Meir survival method, female survival was .57 for 1994-95 with a 95% confidence interval of .2504-.8924 and .60 for 1995-96 with a 95% confidence interval of .2439-.9560.

> "In our model population growth only occurs when parameter combinations are extremely optimistic and likely unrealistic: if female survival and fecundity are high, other parameters can be relaxed to medium or low values. If female survival and fecundity are medium and all other parameters high, a steady decline toward extinction occurs."

At this time, all evidence indicates that female survival and fecundity are not high and thus that the southern Sierra population of the fisher has a very high probability of extinction over a relatively short period of time (10-50 years). Further, the model used by Lamberson et al. (2000) assumes there is no demographic stochasticity and that the environment is stable, and does not consider potential loss of fitness associated with loss of genetic variability. All of these factors would tend to make predictions more dire (Lamberson et al. 2000). In particular, changes to the environment from further habitat loss and fragmentation due to logging and stand-replacing fire are likely to cause population decline, bringing the fisher closer to extinction. Truex et al. (1998) concluded:

> "High natural mortality rates and altered forest structures are risk factors that are compounded by the fact that fishers in the southern Sierra Nevada are separated from those in northern California by a distance of at least 400 km. Thus, the population will probably receive no immigrants to augment its genetic diversity or to rescue it from random events that could lead to its extirpation. Special consideration should be given to the effects of all land management activities on the short and long-term viability of this isolated population."

2. Northern California population

Two studies of fisher demography have been conducted in northern California—one in the Northern California Coast Ranges (North Coast Study) on the Six Rivers National Forest (1992-1997) and another in the eastern Klamath Mountains on the Shasta-Trinity National Forest (1992-present)(Truex et al. 1998). These studies indicate that fisher mortality may be high in northern California and suggest that habitat loss and fragmentation may be harming the existing population. In addition, the northern California population is isolated from fisher populations in the rest of North America and small enough that inbreeding and population viability may be concerns.

Based on known fisher densities in northern California and a probability model of likelihood of fisher detection (Carroll et al. 1999), Carroll (personal communication) estimated there are 1,000-2,000 fishers in northern California[4], suggesting that there are no more than 2,500 fishers in all of California. Similar to the southern Sierra, the estimated size of the northern California population is cause for concern, particularly considering that the population is isolated from the larger continental population, potentially has high female mortality, and habitat loss is continuing (Truex et al. 1998).

Because of loss of the fisher from most of Oregon and Washington, fishers in northern California are reproductively isolated from fishers in the rest of North America. This isolation precludes genetic interchange, increasing the vulnerability of the northern California population. Drew et al. (in litt.) documented that fishers in northern California already have lower genetic diversity than other populations in North America. Lower genetic diversity could be associated with adaptation to local conditions, but is more likely the result of reduction of population numbers with habitat loss (Drew et al. in litt.), and may be resulting in reduced population fitness. Furthermore, isolation makes it unlikely that in the event of population decline, immigration from other populations could temporarily augment the population, rescuing it from extinction.

Vulnerability of the northern California fisher population is furthered by relatively high mortality rates, particularly among females. Truex et al. (1998), for example, concluded: "the higher female than male mortality rates, across all three study areas, raises concern." On the North Coast Study Area, survival rates pooled across years were 83.8% for both females and males (Truex et al. 1998). If fishers with unknown fates were included, however, survival rates were considerably lower. Using the effort-based method, the survival index was 50% individual survival over 8.3 animal monitoring years (ibid.) On the Eastern Klamath Study Area, survival

[4] This estimate is preliminary and may be biased by several assumptions. Population size is estimated based on a "resource selection function" developed by Carroll et al. (1999), assuming that fisher have free and ready access to all habitat, which because of dispersal barriers is likely not the case. In addition, the population estimate is based on a baseline fisher density taken from a study on the Hoopa Valley Indian Reservation (Higley personal communication to Carroll), assuming that this population is in equilibrium (Boyce and McDonald 1999). Changes in density estimates from the Reservation because of sampling error or population fluctuations could substantially alter the total population estimate.

rates pooled across years were 72.9% for females and 85.5% for males (Truex et al. 1998). Although population growth rates have not been modeled, high female mortality in combination with low and highly variable observed fecundity (Truex et al. 1998) indicates that fisher populations in northern California are probably declining or will do so in the future. Significantly, humans were the cause of half of the known mortalities in northern California, including two fatalities to collision with automobiles and two from hunters.

Finally, the northern California fisher population is vulnerable to past and continued loss of habitat from logging. Logging, for example, is believed to be the cause of lower fisher densities, larger home ranges, low capture rates and a high proportion of juveniles in the population in the Eastern Klamath Study Area (Truex et al. 1998). Truex et al. (1998) concluded:

> "Fishers appear to exist in poorer quality habitat in this region than in the others… Some of the differences may be climatic; inland forests receive less moisture and therefore have lower productivity than coastal forests. However, it is clear from the history of timber harvest, and by aerial examination of the three study areas, that the eastern Klamath area has been subjected to more timber harvest—and more by clearcutting—than the other two areas."

If Truex et al. (1998) are correct that low fisher densities in the eastern Klamath relate to logging, continued habitat loss from logging and/or stand-replacing fire may push the population below a sustainable density, whereby Allee Effects and demographic stochasticity lead to additional loss of range in California. This would further isolate the two California populations from each other. Moreover, loss fishers from substantial portions of Oregon and Washington in part because of logging (Powell and Zielinski 1994) provides strong indication that with continued logging the fisher in northern California may be at risk.

B. Oregon and Washington

Current evidence indicates that native populations of the fisher are severely reduced in Oregon and extirpated or reduced to scattered individuals in Washington. In Washington, for example, Lewis and Stinson (1998) concluded:

> "The lack of detections of fishers given the extensive carnivore surveys conducted since 1990, an average of less than four fisher sightings per year since 1980, and few incidental capture by trappers, all indicate that fishers are very rare in Washington and could become completely extirpated. We believe that any remaining fishers in Washington are unlikely to represent a viable population".

Although fisher declines in Washington were probably caused in part by trapping, the failure of populations to recover probably more relates to habitat loss. Lewis and Stinson (1998) concluded:

> "Despite protection from legal harvest for 64 years, the fisher has not recovered. The fisher population may have been kept from recovering by a combination of factors. These factors likely include: a reduction in quality and quantity of habitat due to development and logging; past predator and pest control programs; low inherent reproductive capacity of the species; and demographic and genetic effects of small population size."

In Oregon, the fisher's geographic distribution has been reduced to a small number of individuals near the California border in the Siskiyou Mountains and a small, reintroduced population in the upper Rogue River drainage in the southern Cascades (Aubry et al. in litt., Drew et al. in litt.) Existing information indicates that both populations are small and isolated. Extensive trackplate and photo stations in the Siskiyou Mountains found fishers in five locations, including two in the same township (Aubry personal communication), demonstrating that an comprising a population center, fishers in southwestern Oregon are comprised of individuals that have dispersed from northern California. Similarly, the introduced population in the southern Cascades, which likely stems from release of 11 fishers from British Columbia and 13 from Minnesota between 1977-1981 (Aubry et al. 1996, Drew et al. in litt.), is small and isolated. Indeed, Aubry et al. (in litt.) concluded:

> "The high degree of relatedness among fishers in the southern Cascade Range ($r = .56$) is consistent with the hypothesis that this population is small and isolated."

Population isolation of fisher populations in Oregon is further demonstrated by evidence indicating that there has been no genetic exchange between fishers in the northern Siskiyou Mountains and those in the southern Cascade Range (Aubry et al. in litt.) Similar to the California populations, small size and isolation makes these populations vulnerable to extinction. This vulnerability is heightened by continued logging of late-successional forests in both Oregon and Washington (see below).

Because of the current limited distribution of fishers on the West Coast and because they have been shown to be sensitive to loss of late-successional forests and habitat fragmentation, a panel of leading wildlife biologists, who conducted a population viability assessment for the Northwest Forest Plan (FEMAT 1993), predicted that under Option 9 of the Northwest Forest Plan, the fisher had a relatively low probability (63%) of having a stable, well-distributed population across federal lands in the range of the northern spotted owl, including Oregon, Washington and northern California. Appendix J2 of the "Final Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl" (FEIS)(USDA and USDI 1994) notes that retaining sufficient amounts of course-woody debris and retaining dispersed blocks of late-successional forest around spotted owl activity centers should raise the rating for fisher to 80% and similar mitigation measures were adopted. However, the scientific team who originally performed the viability assessment specifically mentioned retaining coarse-woody debris, as well as prohibiting kill-trapping for martens because of similarity of appearance, but concluded that "none of these mitigations" were likely to "significantly alter the ratings achieved for either martens or fishers," calling into question the later conclusion in the FEIS.

In sum, native populations of the fisher are substantially reduced and are at continued risk from ongoing habitat loss, high mortality rates, and population decline related to reproductive isolation and small population size. Campbell et al. (2000), for example, concluded:

> "In recent decades, scarcity of sightings in Washington, Oregon and the northern Sierra Nevada may indicate fisher extirpation from much of this area (Carroll et al. in press, Zielinski et al. 1996, Aubry and Raley 1999). The Sierra Nevada and northwestern California populations may be the only naturally-occurring, known breeding populations

of fishers in the Pacific region from southern British Columbia to California (Zielinski et al. 1997a)… Moreover, mortality rates of adult female fisher in the southern Sierra population appear to be high (Truex et al. 1998). No empirical population estimates are available for California, but fisher are considered rare… Since fisher occur at lower elevations than American marten, they are more likely to be affected by direct interface with intensive human activities."

IV. Present or threatened destruction, modification, or curtailment of the fisher's habitat or range.

A. Logging

Logging is believed to be one of the primary causes of fisher decline across the United States (Powell 1993) and is probably one of the main reasons fishers have not recovered in Washington, Oregon and portions of California (Aubry and Houston 1992, Lewis and Stinson 1998, Truex et al. 1998). The following sections detail the method, extent and probable effect on the fishers and its habitat of logging in the different portions of the fishers's West Coast range. In particular, we summarize data from several studies that estimated decline of late-successional/old-growth forests (Beardsley et al. 1999, Bolsinger and Waddell 1993, FEMAT 1993, Franklin and Fites-Kaufmann 1996, Morrison et al. 1991, USDI 1990)[5]. Although the fisher undoubtedly occurs in areas not classified as late-successional forest by these studies, numerous studies show that fishers are associated with unfragmented forests with late-successional characteristics (e.g. Dark 1998, Seglund 1996, Truex et al. 1998). Thus, we have cited studies demonstrating late-successional forest decline not as an exact measure of loss of fisher habitat, but instead as an indicator of severity of loss of fisher habitat. USDI (1990) took a similar approach in determining threatened status for the northern spotted owl (*Strix occidentalis caurina*), citing studies of old-growth forest decline as evidence of loss of habitat, while also acknowledging:

[5] The studies varied in use of the terms old-growth and late successional, most using the former and some using both or the latter. In the text, we use late-successional except where the author specifically used old-growth. The studies also differed in their definition of old-growth, making direct comparison difficult. However, all studies point to sharp declines in late-successional/old-growth forests.

> "Current surveys and inventories have shown that while northern spotted owls are not found in all old-growth forests, nor exclusively in old-growth forests, they are overwhelmingly associated with forests of this age and structure."

Based on references cited herein, the above statement similarly applies to the fisher.

1. Sierra Nevada

Logging in the Sierra Nevada has resulted in substantial declines in late-successional forests and removal of key components of fisher habitat, including large trees, snags, and downed logs, multi-layered canopies and high canopy closure, from large portions of the landscape (Beardsley et al. 1999, Franklin and Fites-Kaufman 1996, McKelvey and Johnston 1992). Removal of these components from Sierra Nevada forests has resulted in loss and fragmentation of fisher habitat, particularly in the northern Sierra Nevada where the fisher may be extirpated or is at extremely low numbers.

Sierra Nevada forests include extensive areas of both private and federal lands, including seven National Forests in the range of the fisher (Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sierra and Sequoia). Approximately 28 percent of the fisher's historic range is in the Sierra Nevada is in private ownership (California GAP Analysis Project 1997). Over 50 percent of the private lands capable of providing the mature coniferous forests preferred by fishers as habitat, however, are industrial timberlands (PRIME California Inventory Data 1997).

a. Method and extent of logging in the Sierra Nevada

Unlike the Pacific Northwest, where the majority of logging was accomplished through clearcutting, logging method has varied in the Sierra Nevada, including clearcut, selection, high-grade, salvage, shelterwood, seed tree and overstory removal methods (Verner et al. 1992). The effect of this cutting, however, has been largely the same—the removal of late-successional forest conditions from large portions of the landscape. Verner et al. (1992) concluded:

> "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) concluded:

> " '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."

Though less prevalent than in the Pacific Northwest, extensive clearcutting has occurred in the Sierra Nevada (Appendix 1). Clearcutting was common on Forest Service lands throughout the 1980s and into the mid 1990s, accounting for most of the volume harvested from 1983 to 1987 (McKelvey and Johnston 1992) and is still occurring on private lands. Regardless of method, logging in the Sierra Nevada has resulted in drastic changes in forest structure across the landscape.

By all accounts, the majority of mixed-conifer and ponderosa pine 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, stated:

> "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."

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 fisher. The average diameter of trees on the remaining 19 plots was 40.9 inches with 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's data also indicate that presettlement forests were fairly dense. 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. 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 broad, thereby resulting in dense canopy cover," it is likely that most presettlement Sierran mixed conifer forests had fairly high canopy closure. Bouldin (1999) compared Sudworth's data with data from numerous vegetation plots measured in 1935 and determined that Sudworth had probably selected highly productive sites for sampling, biasing his conclusions. Nevertheless, Bouldin similarly concluded that there have been "drastic decreases in trees >36" diameter," supporting the basic contention that Sierra Nevada forests have been substantially altered since European settlement.

Primarily because of logging, present day Sierran forests are drastically different from those described by Sudworth at the turn of the century. Forests once dominated by trees well over 25 inches diameter are now dominated by trees under 20 inches. McKelvey and Johnston (1992), for example, concluded:

> "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."

Sierra Nevada forests also have fewer large snags and logs, an absence of multi-layered canopies and reduced total canopy cover. Franklin and Fites-Kaufmann (1996) concluded:

> "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."

Overall declines in late-successional 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 that 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 that 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 stated 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) noted that though many stands fail to qualify as old-growth, they have one or more large trees. Presumably a portion of these stands provide potential resting and denning habitat for fishers. 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.

With similar results, Franklin et al. (1996) compared the amount of late-successional forests (LS/OG Ranks 4 and 5) in national parks and national forests in the Sierra Nevada and found that in the former, high quality late successional/old-growth forests occupy 67% of mixed conifer forests, compared to 12% in the latter, indicating an approximate decline of 82% due to logging in national forests. Further, much of the late-successional forest remaining on national forests has been degraded by some selective cutting, or is highly fragmented (Franklin and Fites-Kaufmann 1996).

Loss and degradation of late-successional forests have been particularly severe in the central and northern Sierra Nevada, where logging began early and there are extensive private land inholdings (Leiberg 1902, McKelvey and Johnston 1992, Beck and Gould 1992). The onset of the gold rush in 1849 and later completion of the Southern Pacific Railroad resulted in extensive cutting in the Tahoe-Truckee Basin and surrounding areas prior to 1900 (Leiberg 1902, McKelvey and Johnston 1992). Logging has remained intensive in the northern and central Sierra to the present with the largest volumes removed since World War II. Beesley (1996), for example, noted that:

> "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."

Intensive logging on private lands has furthered loss and degradation of late-successional forests in the central and northern Sierra Nevada. In the fisher's historic range north of Yosemite National Park, approximately 38 percent of the land is in private ownership and is predominantly managed as industrial timberlands—a far larger proportion than in the southern Sierra (Table 3).

Table 3. Data summarized from the PRIME California Inventory Data 1997.

Region	**Counties Included**	**Timberland (thousand acres)**		
		Public	**Industrial**	**Other Private**
North of	Amador, Calaveras,	2,972	1,051	837

Yosemite National Park	Tuolumne, Butte, El Dorado, Glenn, Nevada, Placer, Plumas, Sierra, Tehama, Yuba			
South of Yosemite National Park	Fresno, Tulare, Mariposa, Stanislaus	1,002	0	114
	TOTAL	**3,974**	**1,051**	**951**

Logging on private lands has resulted in almost complete loss of stands with late-successional characteristics. Bias and Gutierrez (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. Further, Beardsley et al. (1999) found that less than 9% of private forestlands in the Sierra Nevada have a mean stand diameter greater than 21" DBH and that less than 2% can be classified as old-growth. These findings indicate loss and fragmentation of late-successional forests and quality fisher habitat over a substantial portion of the fisher's range.

b. Effects of logging on fisher habitat and the fisher in the Sierra Nevada

Logging of both private and federal lands in the Sierra Nevada has had a dramatic effect on fisher habitat, resulting in loss of most fisher habitat in the central and northern Sierra Nevada and contributing to the likely extirpation of the fisher from this portion of the range. For example, Bombay and Lipton (1994) determined that the Eldorado National Forest lacked sufficient habitat to create high quality "fisher use areas" because of an over-abundance of "sparse and open stands" and lack of contiguous mature or late-successional stands. Most high quality habitat was found to occur in patches smaller than 40 acres (ibid.). Bombay and Lipton (1994) concluded:

> "The current vegetation on the Eldorado National Forest appears to provide a limited number of areas which meet the model parameters for habitat to support a fisher reproductive unit. Given this analysis, it would appear that the Eldorado National Forest does not currently have sufficient amounts and distribution of continuous large trees, dense canopied forest to support a population of fisher across the forest."

Similarly, the Lassen National Forest Land Management Plan concluded that "based on existing information, we have limited suitable furbearer habitat on the Forest right now. Existing habitat is being fragmented by continued logging and, in most instances, no longer meets the medium habitat capability for marten and fisher" (USDA Lassen National Forest 1993). Based on similar intensity of logging, extent of private inholdings (e.g. Beck and Gould 1992, McKelvey and Johnson 1992) and probable absence of fishers (Zielinski et al. 1997b), it is likely that the Stanislaus, Tahoe and Plumas National Forests also lack sufficient suitable habitat for the fisher .

Logging impacts on fisher habitat have also been severe in the southern Sierra Nevada, particularly since World War II. For example, annual timber production in Fresno County rose from roughly 37 million board feet in 1947 to a peak in 1975 of 136 million board feet, remaining high into the early 1990s (Bolsinger 1978). This logging, including extensive clearcutting in the 1980s, has resulted in loss of forests with late-successional characteristics and has compounded a high degree of natural fragmentation (Zabel et al. 1992).

In conclusion, widespread logging in the Sierra Nevada over the last century and a half has severely depleted important components of fisher habitat, such as large trees, snags and downed logs, and multi-layered dense canopies, resulting in drastic declines and fragmentation of habitat and contributing to the extirpation or severe reduction of fishers from the northern and central Sierra Nevada. Logging continues to affect the fisher negatively to the present day.

c. Ongoing effects of logging on the fisher

To analyze recent effects of logging on the fisher on national forest lands in the Sierra Nevada, we reviewed Biological Evaluations (BEs), Environmental Assessments (EAs) and other decision documents for Forest Service projects where the agency concluded "may affect individual fishers, but is not likely to lead to a trend towards listing" from 1993 to July 1998. These documents were obtained through a Freedom of Information Act request that specifically asked for documents that determined potential effects to the California spotted owl and thus may only comprise a portion of those where effects on the fisher were determined. In addition, we analyzed recent effects on the fisher of logging on private lands in the Sierra Nevada by analyzing 204 timber planning documents from an area that is important for dispersal of fishers from the southern to the central and northern portions of the Sierra Nevada. These analyses indicate that logging on both Forest Service and private lands is having significant effects on this small and isolated population of the fisher.

i. Sierra National Forest

Between 1993 and 1998, the Sierra National Forest has planned or carried out 48 projects where the biological evaluation concluded "may effect individuals, but not likely lead to a trend towards Federal listing," or similar language (Appendix 2). The majority of these were timber sales (28), followed by general projects (10), recreation (4), livestock grazing (3), prescribed burns (2), and roads (1). Fishers were sighted in the vicinity of five of the projects. Most were not surveyed, however. Timber sales potentially affected 27,026 acres and removed 107.3 million board feet. An additional 6,736 acres were affected by other projects. In total from 1993-1998, 3.9% of the forested area on the Sierra National Forest was impacted by these projects.

Cutting methods in the 28 timber sales included salvage, thinning, sanitation, shelterwood and hazard tree removal. Most followed the Interim Guidelines to protect the California spotted owl (see below). All, as evidenced by the determination of effects, removed or reduced components of quality fisher habitat, such as high canopy closure and multi-layered canopies. In addition, despite a prohibition on cutting trees >30" DBH enacted under the Interim Guidelines, a number of these sales cut larger trees that are used for resting and denning by the fisher. For example, the 10S18 Fuels Reduction Project, which was exempted from the Interim Guidelines as an administrative study, cut over 300 trees >30" dbh, even though cutting such trees does little to nothing to reduce fire danger (van Wagtendonk 1996). Given the strong association of fishers with large trees and snags (Dark 1997, Seglund 1995, Truex et al. 1998), the low numbers of such habitat elements across the landscape (Franklin and Fites-Kaufman 1996), and the high potential for extirpation of the fisher in the near future (Lamberson et al. 2000), administrative studies that remove substantial numbers of large trees, like the 10S18 Fuels Reduction project, are no longer appropriate.

The severity of effects on the fisher varied in the remaining projects. For example, general projects ranged from renovation of existing buildings, likely having a minimal effect on the fisher population, to three separate strychnine poisoning projects over thousands of acres, potentially resulting in loss of prey for or poisoning of fishers, which feed on pocket gophers and other rodents that may be poisoned (Zielinski et al. 1999). Similarly, recreation projects ranged from trail maintenance, in and of itself probably having little impact, to an OHV event, potentially affecting fishers through increased human activity and noise. The effects of prescribed burning on the fisher are unknown at this time. Similarly, the effects of livestock on the fisher have not been studied, although it is known that grazing can depress populations of some small mammals and lizards, potentially reducing prey, and that livestock reduce the density of vegetation in riparian zones, which are utilized by the fisher. The one new road that affected the fisher likely compounded habitat fragmentation from the existing system of roads on the Sierra National Forest.

ii. Sequoia National Forest

Between 1993 and 1998, the Sequoia National Forest planned or carried out 20 projects, where the Forest biologist concluded that it "may affect the fisher, but will not likely lead to a trend towards Federal listing." Eighteen of these projects were timber sales. The other two were recreation related. Fishers were detected in surveys or sighted within the vicinity of 14 of the projects. Timber sales potentially affected 21,755 acres, or 2.4% of the forested area on the Sequoia National Forest, and removed up to 60.6 million board feet. Thinning and salvage were the most commonly utilized cutting methods. The former generally results in reduced canopy closure and ground disturbance both potentially harmful to fisher habitat and the latter potentially removes structures used for resting and denning by the fisher. The two recreation projects included a trail plan for the entire forest and plans to construct the Sirretta Peak Trail. In the latter case, it was determined that the project would increase fragmentation, "affecting the normal travel patterns of fisher and marten."

Considering the small size and isolation of the fisher population (Truex et al. 1998), the negative effects of even one to a few projects should be cause for concern. Overall, the two national forests conducted or planned 68 projects in one five year period that were considered to potentially negatively affect the fisher. Considered individually each project may not lead to a trend towards Federal listing. However, considered cumulatively and in the context of the considerable past habitat loss and fragmentation that has occurred on these forests, it is clear that this fragile fisher population and its habitat are being negatively affected, necessitating listing under the Endangered Species Act.

iii. Private lands

Because of large private land in-holdings, the northwest portion of the Stanislaus National Forest was identified as an Area of Concern (AOC) for the spotted owl, which similar to the fisher is associated with late-successional forests (Beck and Gould 1992). This AOC is within the range of the fisher and situated in a region that would be important to the northward dispersal of fishers. To assess the type of harvest activity occurring in an area dominated by private lands important to fisher dispersal, we examined timber planning documents prepared between 1990-1998 on five sites within this AOC. Sites were 8,000 acre circles where any timber planning document that had some or all cutting units within the circle were analyzed.

For the nine year period monitored, 204 timber planning documents were filed for a total of 938,294 acres to be treated. Twenty-seven of these documents (18,572 acres) were filed as emergencies primarily for the removal of insect damaged trees, and 109 documents (881,595 acres) were filed as exemptions primarily to treat dead, dying, or deteriorating trees. Timber harvest plans (THPs) were filed in 68 instances covering 37,947 acres.

The number of THPs and exemptions filed and their respective acreage varied somewhat by year for the period 1990 to 1999 (Table 4). The patterns suggest that harvest operations were not declining over this period and appear to be somewhat stable with a slight increase after 1995.

Table 4. Harvest documents proposing activity within five 8,000-acre regions in the northwest quarter of the Stanislaus National Forest.

Year	Number of THPs	THP acreage	Number of Exemptions	Exemption Acreage	Number of Emergencies	Emergency Acreage
1990	5	3,125	14	110,894	17	11,662
1991	8	4,926	12	91,434	5	14,520
1992	6	2,255	12	12,272	0	0
1993	5	2,876	7	45,874	2	1,800

1994	7	2,753	13	74,486	0	0
1995	6	4,272	13	73,692	0	0
1996	14	7,992	15	190,087	0	0
1997	8	4,998	13	125,929	1	60
1998	6	4,750	8	104,952	2	710
TOTAL	**68**	**37,947**	**109**	**881,595**	**27**	**18,572**

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 example illustrates the pattern. Exemptions were filed 4 times on the same 39,000 acre area each year between 1993 to 1996. During this same period and in this same area, 12 THPs totaling 7,161 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 fisher habitat. Despite the magnitude of effects to fishers, the impacts of these harvest activities on the fisher or its habitat are not disclosed or mitigated in the harvest documents.

Since the required documentation for emergencies and exemptions is limited to a 1 to 2 page application, our detailed review focused on the more extensive information provided in the 68 THPs. The vast majority of the THPs were submitted by industrial forest operations (61 THPs covering 37,457 acres). As can be seen in Table 4, the number of acres harvested has increased somewhat from 1990 to 1999. The type of prescription used most frequently over that period also has changed. Early in this period, clearcutting was used occasionally, whereas after 1995, this prescription became dominant in the THPs we reviewed. This pattern also is reflected in statistics gathered from THPs throughout the Sierra Nevada for the period 1994 to 1999. Between 1994 and 1999, there was a seven-fold increase in acres harvested with a clearcut prescription on private timberlands in the Sierra Nevada (Table 5).

Table 5. Data reported from California Department of Forestry.

Prescription	**Acres Harvested**					
	1994	**1995**	**1996**	**1997**	**1998**	**1999**
Clearcut	1,197	577	3,673	2,042	4,785	8,600
Other prescriptions	40,181	33,548	60,725	27,822	18,519	13,982
Clearcut as a Proportion	2.9	1.7	5.7	6.8	20.5	38.0

of Total Acres Harvested						
Total Number of THPs	221	206	223	146	140	110

None of the THPs we reviewed identified the cumulative effects of the numerous timber sales occurring in and around each of the five areas. Further, of the 68 THPs, only four mention the presence of late successional forests in the analysis area, and none identify impacts to late successional forests. Three of the THPs identify that fishers were sighted in the area in 1965, but no additional mitigation measures for this species or others associated with late-successional forests were identified.

In sum, past and ongoing timber practices on private lands have resulted in a highly fragmented landscape with heavily thinned forest having few trees over 21" in diameter broken up by large gaps in forested vegetation created by even-aged management. This vegetation pattern is more extensive north of Yosemite National Park, presenting a serious challenge to fisher dispersal from the populations in the southern Sierra Nevada northward.

2. Northern California

Logging in northern California on both private and federal lands has also resulted in substantial loss and fragmentation of late successional forests and fisher habitat. Although fishers persist in northern California in greater numbers than elsewhere on the West Coast, there is some indication that logging has resulted in reduced fisher densities (Truex et al. 1998).

The current northern California range of the fisher includes four national forests—the Six Rivers, Mendocino, Klamath and Shasta-Trinity—found in six counties (Del Norte, Humboldt, Mendocino, Siskiyou, Shasta and Trinity Counties). Roughly 80% of the forested area in the three coastal counties (Del Norte, Humboldt and Mendocino) is privately owned, including large tracts of industrial timberlands (Waddell and Bassett 1996). In contrast, a majority (about 62%) of the forested area in the interior counties is publicly owned (Waddell and Bassett 1997).

a. Method and extent of logging in northern California

Logging in northern California has been a mix of clearcutting and selective methods. Clearcutting is the predominant method in moister coastal and more northerly forests, but has occurred in all areas. Regardless of method, however, logging in northern California has resulted in substantial loss of late-successional forests and quality fisher habitat.

Bolsinger and Waddell (1993) estimated there are roughly 668,250 acres of old-growth on federal lands in northern California or roughly 14.9% of the forest acres. Considering that old-growth may have occupied as much as 70% of the landscape prior to European settlement (USDI 1990), this indicates old-growth in northern California may have declined by as much as 79% on federal lands in northern California. Similarly, Morrison et al. (1991) estimated there were 798,300 acres of old-growth on the western portions of the Klamath and Shasta-Trinity National Forests, and all of the Six Rivers National Forest. In contrast, FEMAT (1993) estimated that there are 1,470,800 acres of multi-storied stands with trees over 21" in diameter, which they characterized as late-successional, on federal lands in northern California or roughly 32.8% of federal lands. Although not characterized as old-growth by Bolsinger and Waddell (1993), some of the additional acres identified by FEMAT (1993) probably provide habitat for the fisher. However, more than half of these acres occur at elevations greater than 1,200 m, indicating a much smaller proportion of the landscape within the elevational range utilized by the fisher is occupied by late-successional forests as defined by FEMAT (1993). In addition, according to FEMAT (1993) "late-successional/old-growth forests" on federal lands are "typically highly fragmented by harvested areas and stands of younger trees." Fragmentation likely makes many old-growth forest stands unavailable to the fisher because of its aversion to crossing areas of little forest cover (Powell 1993, Rosenberg and Raphael 1986).

On private lands in northern California most stands are even-aged and less than 100 years old (Waddell and Bassett 1996 and 1997). Bolsinger and Waddell (1993) estimated there were only roughly 780,800 acres of old-growth on private lands in the north coast and north interior resource areas of California, a portion of which is outside the present range of the fisher. This amounts to roughly 15.7% of private lands in these areas (Waddell and Bassett 1996 and 1997). Many of these stands, however, have been entered for harvest (Bolsinger and Waddell 1993). Bolsinger and Waddell (1993), for example, concluded that:

> "On private lands, most of the 1,423,000 acres classified as old-growth [in Washington, Oregon and northern California] consist of stands from which old trees have been removed. Mixed-conifer stands in California make up the bulk of these forests. They have been selectively logged one to several times over the past century, but they still contain three of the four major elements of the ecological definition of old-growth forest—mature or overmature trees, multilayered canopy with several age groups represented, and snags and coarse woody material on the ground."

The proportion of these stands that provide high-quality habitat for the fisher is unknown. However, remaining old-growth on private lands is probably even more fragmented than on federal lands. FEMAT (1993), for example, concluded:

> "Late-successional/old-growth stands that remain on private and state lands tend to typically occur in small patches surrounded by cutover areas and young stands."

b. Effects of logging on the fisher in northern California

Loss, degradation and fragmentation of late successional forests because of clearcut and selective logging in northern California has resulted in substantial loss of fisher habitat with likely negative affects on the fisher. Although studies on the direct effects of logging on the fisher in northern California are limited, information in both Buck et al. (1994) and Truex et al. (1998) indicate that loss of habitat because of logging has affected fisher populations in northern California. Buck et al. (1994) in a study comparing the fisher's use of adjacent lightly and heavily harvested areas in northern California found that fishers were more selective in the heavily harvested area, avoiding areas where most of the conifer overstory had been removed. They further speculated that by reducing the quantity and distribution of quality habitat, logging may force fishers into sub-optimal habitat, ultimately increasing fisher mortality and lowering reproduction, concluding:

> "If timber management practices create timber-types that are sub-optimal, then survival and reproduction of fishers should decrease within these timber types. Some evidence supports this hypothesis: 7 radio-collared fishers died during our study—2 adult males, 1 adult female and 4 juveniles. All were recovered in habitats considered sub-optimal by our analysis: clear-cuts, areas without overhead canopy cover, and hardwood dominated stands."

Similarly, Truex et al. (1998) found that fisher densities were lower and home ranges larger in their eastern Klamath Study Area than in their North Coast Study Area and speculated that this was because of observed "poorer habitat quality" on the former due to extensive clearcutting, concluding:

> "a number of independent indices of forest structure, habitat use, and demography suggest that the eastern Klamath population occurs in poorer habitat and may be more characteristic of 'sink' habitat than either of the other study areas."

Both of these studies suggest that reductions in the quantity and quality of fisher habitat because of logging in northern California has reduced fisher density and survivorship. The negative effects of logging on fisher populations in northern California are continuing to the present.

c. Ongoing effects of logging in northern California

Similar to the Sierra and Sequoia National Forests, we quantified recent effects of logging and other projects on the fisher on the Klamath, Six Rivers, Shasta-Trinity and Mendocino National Forests by requesting and reviewing all Biological Evaluations (BEs), Environmental Assessments (EAs) and other decision documents for projects where the agency concluded "may affect individual fishers, but is not likely to lead to a trend towards listing" from 1994 to the present, or since the Northwest Forest Plan was enacted. Documents were obtained through the Freedom of Information Act.

i. Klamath National Forest

Between 1994 and the present, the Klamath National Forest planned or carried out 52 projects where a biological evaluation concluded that the project “may affect” individual fishers, including 32 timber sales, 8 general projects, 3 prescribed burns, and 3 road, 3 mining and 3 recreation projects. Fishers were sighted, found in surveys or occurred in a historical record in the vicinity of 23 of these projects. Most projects were not surveyed for fishers, however, suggesting that more projects may have occurred in areas utilized by the fisher.

Timber sales potentially affected at least 23,177 acres and removed at least 70 million board feet. Salvage logging was the most commonly identified prescription (18), followed by thinning (15), sanitation (5), shelterwood (5), overstory removal (2), group selection (2) and clearcutting (2). All of these prescriptions potentially led to removal of structures associated with quality fisher habitat, such as canopy cover and large snags, trees and logs.

Five of the eight general projects were gopher poisoning, which, as mentioned previously, could lead to poisoning of fishers. Other general projects included forest clearing for a powerline, watershed restoration and forest disease control. Road projects included reconstruction of a road and various road maintenance tasks. Mining projects included permits for two separate mines and drilling of exploratory wells. Recreation projects included construction of a corral and trail maintenance.

ii. Mendocino National Forest

Since the Northwest Forest Plan was enacted, the Mendocino National Forest planned or carried out 31 projects, where a forest biologist determined they may affect individual fishers, including 21 timber sales, 5 general projects, 4 recreation projects and 1 burn. Surveys for fishers were not conducted in association with most if not all of these projects, but fishers were sighted in the vicinity of seven of the projects.

Salvage was the most commonly identified prescription for timber sales (10), followed by thinning (3) and shelterwood (1). We lacked information on prescription for a number of sales because we only received biological evaluations and not environmental assessments, which are generally more detailed. Timber sales potentially affected at least 8,622 acres and removed at least 51.3 million board feet.

General projects, which included tree planting and wildlife habitat enhancement, probably had fairly minor effects. The two road projects were both permits for hauling timber and the four recreation projects were all OHV events. Both timber hauling and OHVs have the potential to disturb fishers.

iii. Shasta-Trinity National Forest

Between 1994 and the present, the Shasta-Trinity National Forest conducted 23 projects where it was determined that they "may affect" individual fishers and 13 where it was determined that they will "likely" affect individual fishers, but not lead to a trend towards federal listing. Timber sales accounted for 32 of the projects with 2 general projects and 2 road projects accounting for the remainder. Fishers were sighted in the vicinity of 12 of the projects with most of the remainder not surveyed.

Timber sales potentially affected at least 30,900 acres and removed at least 51.9 million board feet. Salvage and hazard tree logging were by far the most commonly identified prescriptions (25), followed by thinning (8), sanitation (5), overstory removal (3), group selection (1) and clearcutting (2). As noted previously, all of these prescriptions can result in the removal or degradation of fisher habitat.

The two general projects consisted of construction of a phone line and a land exchange, and the two road projects consisted of a maintenance project and a programmatic evaluation of road use permits, with varying effects on the fisher.

iv. Six Rivers National Forest

Between 1994 and the present, the Six Rivers National Forest conducted 36 projects where it was concluded in a biological evaluation that the project "may affect" the fisher, including 17 timber sales, 11 road projects, 5 prescribed burns, 2 general projects and 1 recreation project. Fishers have been recorded in surveys or sighted in the vicinity of at least 18 of these projects.

Timber sales potentially affected at least 11,152 acres and removed 37.7 million board feet. The most commonly identified prescription was thinning (10), followed by salvage (6), clearcutting (3) and shelterwood (1). Clearcutting probably produced the most volume, as the Pilot Creek Ecosystem Management Project, which included clearcutting, was expected to remove roughly 15 million board feet alone. Seven fishers, some known to have reproduced, were found in this timber sale's project area.

Road projects consisted of both maintenance and construction and likely contributed to habitat fragmentation for the fisher. The effects of the five prescribed burns on the fisher are unknown at this time. The two general projects consisted of construction of a fireline and a lookout tower. Construction of a trail and maintenance of a campground was the one recreation project.

v. Summary of effects

Since 1994, the four national forests planned or conducted 155 projects where it was determined fishers may be affected. These determinations were made by qualified biologists who were required to visit the project sites before making their determination. Considered alone, any one of these projects might not lead to a trend towards federal listing. Considered cumulatively and in the context of considerable past habitat loss and degradation, however, it is clear that Forest Service projects are having a substantial impact on fisher habitat. Significantly, this analysis does not consider the numerous timber sales and other projects occurring on private lands in northern California, where it is reasonable to assume that there have been a large number of projects that potentially affected the fisher.

A majority of "may affect" determinations (105 of 159, 66%) resulted from timber sales with salvage logging being the most commonly identified prescription. This is of concern because salvage logging removes large snags and logs used by the fisher for resting and denning and because requirements for "green tree retention" under the Northwest Forest Plan do not apply to salvage sales. Other prescriptions, such as thinning, clearcutting, overstory removal and shelterwood, have also led to loss of fisher habitat. In sum, logging has resulted in substantial loss of fisher habitat in California and continues to present a threat to the fisher.

3. Oregon and Washington

Extensive clearcutting on both private and federal lands in Oregon and Washington has resulted in substantial loss, degradation and fragmentation of fisher habitat. Such habitat loss has likely contributed to the extirpation of native fisher populations from most of Oregon and Washington (Aubry and Lewis in litt., Aubry et al. 1996, Aubry and Houston 1992, Lewis and Stinson 1998, Powell 1993). Powell and Zielinski (1994) concluded:

> "It is our opinion that the precarious status of the fisher population in Washington and Oregon is related to the extensive cutting of late-successional forests and the fragmented nature of these forests that still remain. Fishers appear sensitive to loss of contiguous, late-successional Douglas-fir forests in the Pacific Coast Ranges, west slope of the Cascade Range, and west slope of the Sierra Nevada"

There are five national forests in the historic range of the fisher in western Washington—Olympic, Mt. Baker-Snoqualmie, Okanagan, Wenatchee and Gifford Pinchot. These national forests occupy 29% of Washington's productive forest land, primarily in the Cascade and Olympic Mountains (Bolsinger et al. 1997). Other public lands, mostly state, but also National Park Service and Bureau of Land Management, occupy another 15% of Washington's productive forests. The remainder are owned by forest industry (14%) and small landowners (36%). Considering western Washington alone, where the bulk of the fisher's range is found, 39% is owned by forest industry, 21% by small landowners, 23% is national forest and 17% is other public (ibid.) Private ownership is highly skewed towards low elevation, productive lands.

In Oregon, there are eight national forests in the historic range of the fisher, including the Mt. Hood, Willamette, Umpqua, Rogue River, Siskiyou and Siuslaw west of the Cascade Crest, and the Deschutes and Winema east of the Cascade Crest. In western Oregon, 34% of the productive forest land is national forest, 15% is Bureau of Land Management, 6% is state and other public, 28% is forest industry and 18% is other private (small landowners)(Gedney 1982). Similar to Washington, the most productive, low elevation lands are privately owned. FEMAT (1993) provides analysis of amounts of late successional forest in Oregon and Washington within the range of the northern spotted owl. It is unknown the degree to which the ranges of the owl and the fisher correspond. However, all of the same national forests are included within both ranges, indicating a reasonable correspondence.

a. Method and extent of logging in Washington and Oregon

Clearcutting is the predominant method of logging in Oregon and Washington and has resulted in "a highly fragmented mosaic of recent clearcuts, thinned stands and young plantations interspersed with uncut natural stands." (FEMAT 1993). Unlike selective cutting, clearcutting results in the immediate removal of late-successional characteristics and quality fisher habitat, such as large trees, snags and logs, and multi-layered canopies. Lewis and Stinson (1998), for example, conclude:

> "Even-aged management degrades fisher habitat by periodically removing the canopy and reducing the abundance of snags, cavity trees, and coarse woody debris (Ohmann et al. 1994)."

Losses of late successional forests in Washington and Oregon have been substantial. Bolsinger and Waddell (1993) estimate that old-growth forests in all of Washington declined from 9.1 to

2.8 million acres between 1933-45 and 1992—a roughly 69.2% decline. In Oregon, they estimate old-growth forests declined from 14.2 to 4.9 million acres—a 65.5% decline (note: these figures include some areas in eastern Washington and Oregon that are outside the range of the fisher). Although there is no way of knowing the amount of old-growth forest logged prior to 1933, it is likely that it was substantial and indeed Bolsinger et al. (1997) concluded "there is no doubt that Washington's forests were heavily exploited in the 1800s and the early part of the 1900s." Thus, the above figures for decline are clearly underestimates. USDI (1990) concluded that approximately 70% of all forested lands may have been old-growth prior to European settlement and that declines may be in the range of 83-88%.

FEMAT (1993) estimated that multi-storied stands with trees over 21" diameter occupy 1,633,100 acres on federal lands in Oregon and 1,394,600 acres on federal lands in Washington within the range of the northern spotted owl, amounting to 18.2% and 19.9% of the federal forest acres in the two states, respectively. Similarly, Morrison et al. (1991) estimated there are 1,862,000 acres of ancient forest in western Oregon National Forests and 1,117,100 acres of ancient forest in western Washington National Forests. Significantly, FEMAT (1993) documented that a substantial portion of late-successional forests are over 4,000 feet in elevation—35.9% of late-successional forest acres in Oregon and 46.9% in Washington—indicating that west of the Cascades many of the old-growth acres are outside the primary elevational range utilized by the fisher (e.g. Aubry and Houston 1992).

Loss of late-successional forest has been particularly severe on private lands in Oregon and Washington. Bolsinger and Waddell (1993) estimate that on private or tribal lands there are only 112,295 acres of old-growth in Washington and only 145,557 acres of old-growth in Oregon. This is less than 2% of private forest lands in both states. Significantly, private lands occupy productive, low elevations forest lands that once supported high quality fisher habitat. Bolsinger and Waddell (1993), for example, concluded:

> "The largest and most impressive of the Douglas-fir forests generally were below 2,000 feet in elevation on level branches and gently sloping hillsides. Most of the forest land at these lower elevations is in private ownership, and most of the privately owned old-

> growth has been logged, usually by clearcutting. Some areas have been clearcut twice, and the land is now occupied by the third generation of forests since settlement."

A large portion of low elevation private lands have been converted from mixed species stands of western hemlock, Douglas-fir and other species to short rotation, monotypic Douglas-fir plantations (Lewis and Stinson 1998). It is unlikely that such plantations provide suitable habitat for the fisher (ibid.) Bolsinger et al. (1997) concluded:

> "Forests on private lands continue to change in character, as older stands of mixed species are replaced with Douglas-fir, and rotations are shortened. Industry lands are mostly occupied by early seral stands of conifers; currently these lands, although well stocked, support the lowest volume per acre of any ownership."

Similarly, Lewis and Stinson (1998) concluded:

> "Most of the low elevation late-successional forest that was suitable fisher habitat has been converted to short-rotation plantation or non-forest uses, and forests are fragmented by highways, railroads, powerlines and residential development."

In sum, fisher habitat has been severely depleted on federal lands and has been virtually liquidated on private lands in Oregon and Washington.

b. Effects of logging in Oregon and Washington on the fisher

Logging, primarily by clearcutting, on both federal and private lands has resulted in severe loss, degradation and fragmentation of fisher habitat. Lewis and Stinson (1998) concluded:

> "Short rotations can prevent the formation of large-diameter trees needed to produce cavity trees, snags, and logs that fishers use for den sites. Although young stands may support relatively high numbers of snowshoe hares, young managed forests support lower numbers of some fisher prey, including squirrels and forest-floor small mammals. Lyon

> et al. (1994) wrote that a landscape of mostly early successional stands and small patches of mature forest is unlikely to provide suitable habitat for fishers… If young, even-aged managed forest is incapable of supporting fishers, then suitable fisher habitat may be very limited and extremely fragmented."

Loss of habitat because of logging likely contributed to the decline of the fisher across Washington and Oregon and has almost certainly contributed to their failure to recover following prohibitions on trapping (Lewis and Stinson 1998, Powell 1993). USDI and USDA (1994) concluded in Appendix J2 of the FEIS that:

> "Thus, fisher populations are believed to have declined on Federal lands within the range of the northern spotted owl for two primary reasons, both of which are related to the widespread conversion of old-growth Douglas-fir forests to young plantations: loss of habitat due to forest fragmentation resulting from clearcutting designed in a staggered-setting prescription, and the removal of large, downed coarse woody debris and snags from the cutting units."

c. Ongoing effects on the fisher of logging in Oregon and Washington

The fisher is not listed as a sensitive species by the Forest Service in Oregon and Washington. As a result, the Forest Service is not required to determine the effects of projects on the fisher and thus we were not able to quantify recent effects on the fisher in the same manner as in California. Other evidence, however, indicates that logging has continued in fisher habitat in Oregon and Washington and in at least one case in an area where a fisher has been sighted. A fisher was sighted within the boundaries of the Sturgis Fork Timber Sale on the Rogue River National Forest by a Forest Service Wildlife Biologist. This recent (ca. 1998) timber sale planned to cut 7.9 million board feet on 1260 acres using group selection and commercial thinning methods, reducing canopy closure to as low as 30% and including construction of 3.7 miles of road.

Logging of late-successional forests has continued under the Northwest Forest Plan, which was enacted in 1994. Indeed, the Plan relies on the liquidation of roughly 17% of remaining late-successional forests to meet timber volume targets (see below)(USDA and USDI 1999). Given that fisher habitat is already limited in Oregon and Washington and that the species has largely been extirpated from the two states, allowing the loss of a substantial amount of late-successional forest is counter to the recovery and survival of the fisher on the West Coast.

B. Roads

In addition to the effects of logging on fisher habitat, roads also have significant effects. Roads result in the loss and fragmentation of habitat (table 6), create barriers to fisher dispersal, cause death directly through vehicular collision, and allow access to poachers (Dark 1997, Freel 1991, Wisdom et al. 2000, Witmer et al. 1998). Areas with higher road densities have also been found to support lower densities of large trees, snags and downed logs than areas with fewer roads because of the access provided for fuelwood cutting and logging (Quigley and Arbelbide 1997).

The fisher's range on the West Coast is heavily dissected by roads. In the Sierra Nevada, a total of 25,000 miles of road have been constructed on public lands alone (USDA 2000), causing dramatic loss and fragmentation of habitat. Similarly, a total of 109,443 miles of road have been constructed in Oregon, Washington and northern California on federal lands in the range of the northern spotted owl (FEMAT 1993). Countless more roads have been constructed on private lands. Numerous large state and interstate highways create barriers for the fisher, limiting recovery and isolating existing populations. For example, all of the known fisher locations in the Sierra Nevada occur south of the southernmost of four highways that cross the range (Zielinski et al. 1997a). These highways probably contributed to declines of the fisher in the central and northern Sierra and are likely a barrier to reconnecting the southern Sierra and northern California populations. Witmer et al. (1998), in a review of issues related to the conservation of the fisher in the Interior Columbia Basin, concluded:

> "Barriers to movement may include large nonforested openings and highways. Maintenance of links between individuals and populations will require elimination or reduction of these barriers."

Mortality associated with roads poses a serious threat to small fisher populations, such as in the southern Sierra. Indeed, four fishers were killed by vehicles in Yosemite National Park between 1992 and 1998 (Chow personal communication). Campbell et al. (2000) concluded:

> "Loss of individuals from a small isolated population may hasten decline. Of particular concern are collisions between fisher and vehicles. Many records of fisher locations are in the form of roadkills."

Truex et al. (1998) recommended that increases in paved roads or vehicle speed should be discouraged in areas managed for fishers.

C. Development

Development of private lands is a threat to the fisher throughout its range, having much the same effect on fisher habitat as does logging. McBride et al. (1996) measured forest conditions in both developed and undeveloped areas in various forest types of the Sierra Nevada, 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, is counter to maintaining fisher habitat.

Population growth has been dramatic in all three West Coast states and is predicted to continue. The human population of the Sierra Nevada, for example, 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. Similarly, in Oregon the population is expected to grow from 3,282,000 in 1998 to 3,992,000 in 2015, or roughly 18% in just 17 years, and in Washington the population is expected to grow from 5,689,000 in 1998 to 7,058,000 in 2015, or roughly 19% in 17 years (Population Reference Bureau 1999).

Development in California, Oregon and Washington is resulting in direct conversion of forest land in the historic range of the fisher (table 6). Bolsinger and Waddell (1993), for example estimate that productive forest lands declined by three million acres from 1930 to 1992 in California, Oregon and Washington and concluded that:

> "The major causes of the decrease in forest area were construction of roads, reservoirs, powerlines and clearing for urban expansion and agriculture."

In the 1980s alone, losses of forest area in Washington were nearly 300,000 acres, mostly in western Washington (McKay et al. 1995, Maclean et al. 1992). In western Oregon, 247,000 acres of forest were lost between 1961 and 1986 (MacLean 1990) and in the north coast area of California 47,000 acres were lost between 1984 and 1994. This is only considering forested lands that were directly converted to another use, such as a house or a road. Numerous other areas have been invaded by dispersed development. Bolsinger et al. (1997) estimated that a total 424,000 acres of large, contiguous blocks of forest, which they termed "primary forest", were lost in Washington State between 1980-1991, mostly in western Washington. We lack similar estimates for loss of primary forest in the other states, but given the extent of population growth in Oregon and California, losses in these states are probably on the same order as in Washington.

Table 6. Loss of productive forest land to roads, and agricultural and urban development on private lands in the West Coast range of the fisher.

Area	Acres of forest converted to:			Total (acres)	Period	Source
	Roads	Agriculture	Urban			
CA, OR, WA				3,000,000	1930-1992	Bolsinger and Waddell 1993
Northern and central Sierra	7,000			7,000	1984-1994	Waddell and Bassett 1997a
N. Coast California	17,000	9,000	21,000	47,000	1984-1994	Waddell and Bassett 1996
N. Interior California	8,000			8,000	1984-1994	Waddell and Bassett 1997b
Western Oregon	54,000	135,000	43,000	247,000 (15,000 to water)	1961-1986	MacLean 1990
Eastern Washington	33,000	15,000	26,000	74,000	1980-1991	McKay et al. 1995
Western Washington	123,000	38,000	63,000	224,000	1979-1989	MacLean et al. 1992
Loss of primary forest in Washington				427,000	1980-1991	Bolsinger et al. 1997

D. Recreation

Recreation can affect fishers negatively through noise and direct disturbance by people. If such disturbance occurs regularly on particular trails or roads it can result in loss and fragmentation of habitat. Loss of habitat can also occur from construction of infrastructure for recreation, for example, roads or skislopes. In a review of the effects of proposed management on forest carnivores in the Sierra Nevada, Campbell et al. (2000) provided the following summary of the potential effects of recreation:

> "That recreational activities can have substantial impacts on wildlife species is widely acknowledged, but this relationship is poorly understood (Knight and Gutzwiller 1995). Recreation activities can alter behavior, cause displacement from preferred habitat, and decrease reproductive success and individual vigor. Peak recreation levels often coincide with the most critical phases of the species life cycle such as during breeding and reproduction. Flight from human presence and interruption of behavior increases energetic costs experienced by an individual."

Recreational use and impacts are particularly intense in the southern Sierra. 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 Sierra with potentially negative consequences for the existing fisher population. Duane (1996b) stated:

> “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.”

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 fisher. 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.”

Substantial recreational use also occurs in other portions of the fisher’s range on both national park and national forest lands. Redwood, Crater Lake, Mt. Rainer, Olympic and North Cascades National Parks are all in the range of the fisher and all receive significant numbers of visitors (table 7). The effects of recreation on the fisher or its habitat in these national parks has not been explored. However, well used roads and trails in these parks have probably resulted in some level of habitat fragmentation and probably impede fisher movement and dispersal.

Table 7. Number of visitors to national parks in the West Coast range of the fisher in 1999.

National Park	Visitors
Sequoia	873,229
Kings Canyon	559,534

Yosemite	3,493,607
Redwood	369,726
Crater Lake	417,999
Mt. Rainer	1,291,397
Olympic	3,364,266
North Cascades	21,488

Similarly, on national forests outside the southern Sierra recreational use is substantial (table 8). The types of recreation allowed in national forests have the potential to do substantially more harm to fishers than in national parks. Activities, such as OHV races, which are not allowed in national parks, have a greater likelihood of resulting in disturbance to the fisher. The amount of development in support of recreation is also potentially greater on national forests, including construction of ski slopes and RV campgrounds.

Table 8. Annual recreation visitor days (RVDs) on national forests in the range of the fisher in Oregon and Washington (Unpublished data provided by Region 6 of the U.S. Forest Service).

State	National Forest	RVDs
Oregon	Deschutes	3,292,640
	Mt. Hood	1,970,950
	Rogue River	1,245,650
	Siskiyou	1,363,170
	Siuslaw	2,704,060
	Umpqua	1,484,120
	Willamette	12,499,660
	Winema	677,530
Washington	Gifford Pinchot	5,592,500
	Mt. Baker-Snoqualmie	6,457,540
	Okanogan	1,261,040
	Olympic	602,750
	Wenatchee	3,574,690

V. Other natural or manmade factors affecting the continued existence of the fisher

A. 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 of the Sierra

Nevada, Klamath/Siskiyou Region and east of the Cascades in Oregon and Washington, and that loss of fire from these systems because of livestock grazing, fire suppression and other factors has resulted in changes in forest structure (Agee 1993, Covington and Moore 1994, Kilgore and Taylor 1979, Swetnam and Baison 1994, Swetnam et al. 2000, Quigley and Arbelbide 1997, Touchan et al. 1993, Weatherspoon et al. 1992). Increased fuel loadings related to these changes have increased the likelihood of large crown fires in these forest types (ibid.) These crown fires pose some risk to existing fisher territories and habitat.

Creating a quandary for land managers, solutions to the problems of increased fuel loadings and likelihood of crown fire, such as prescribed fire and thinning, also pose some risk to fisher habitat. For example, large trees and snags required for resting and denning by the fisher, which are already at low levels in the Sierra Nevada (Franklin and Fites-Kaufman 1996), could potentially be further reduced by fuels treatments.

While it is clear that there is a risk that fisher territories and habitat will be destroyed by crown fire in the future, it is important to recognize that late-successional, mixed conifer forests, where the fisher is generally found, are at lower risk of crown fire than other seral-stages and forest types. High canopy closure, which keeps fuels moist, and large trees, which are generally fire resistant, make late-successional, mixed conifer forests far less likely to burn. Weatherspoon et al. (1992), for example, 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."

Although the above quote is specifically discussing risk to the owl, the same conclusions can be drawn for the fisher because it uses very similar habitat. USDA (2000), in a discussion of fire risk in the Sierra Nevada, determined that only 5% of areas designated as "old forest emphasis areas" were categorized as having the highest fire hazard and risk, compared to 25% for the Sierra Nevada as a whole. The document concludes:

> "The highest hazard and risk areas were often adjacent to (rather than within) patches of old forests, California spotted owl PACs, and critical aquatic refuges."

In addition, the fisher's aversion to human activity and high use roads (Dark 1997) means they are less likely to occur in areas where fire could potentially threaten human life and property.

All of these factors indicate that a cautious approach to fuels treatments should be taken that does not compromise fisher habitat in the short-term in order to save it from the unknown risk presented by catastrophic fire. Such an approach should focus on prescribed fire and limited thinning in areas of highest risk, which as noted above, are generally outside of existing fisher habitat.

B. Population size and isolation

Independent of any anthropogenic factors, fisher populations may be at risk because of isolation and small population size, particularly the southern Sierra population (Campbell et al. 2000, Lamberson et al. 2000, Truex et al. 1998). Small, isolated populations are at risk of extirpation because of demographic and environmental stochasticity, inbreeding depression and Alee effects. These factors can lead to irreversible population crashes (e.g. Hanski and Moilanen 1996). Campbell et al. (2000), for example, concluded:

> "Low population densities combined with low reproductive rates and relatively high individual longevity hamper recovery from impacts and retard the ability to recolonize areas from which they have been extirpated, even in the presence of suitable habitat."

The southern Sierra population is estimated to be comprised of no fewer that 100, but no more than 500 individuals (Lamberson et al. 2000) and the northern California population is estimated to have between 1,000 and 2,000 individuals (Carroll personal communication). The small size of both of these populations places them at risk of extinction from declines related to demographic and environmental stochasticity such as fluctuations in gender ratio or climatic events that result in reduced prey abundance or poor fisher survival (Pimm et al. 1988). Such risk is increased by the isolation of these populations, which ensures that when population declines occur there will be no immigration to rescue the populations. Isolation also places the two populations at risk from inbreeding depression. Indeed, Drew et al. (in litt.) have already determined that remaining populations in California have reduced genetic diversity compared to fisher populations in British Columbia. Finally, as a top-level predator, fishers naturally occur at low densities. This makes them inherently more vulnerable to extinction because as populations decline due to habitat loss and other factors, Alee effects become ever more likely (Pimm et al. 1988).

VI. Predation

Predation appears to be an important source of mortality for the fisher (Buck et al. 1994, Truex et al. 1998). Of 16 mortalities recorded by Truex et al. (1998) with a known fate, nine were suspected to have resulted from predation. Similarly, Buck et al. (1994) documented that four of seven mortalities in northern California resulted from predation. Potential predators include other carnivores, such as mountain lion, bobcat and coyote, and large raptors, such as golden eagle, great horned owl or northern goshawk (Powell 1993, Powell and Zielinski 1994, Truex et al. 1998). Truex et al. (1998), for example, documented several mortalities, including suspected predation from coyotes in two cases, mountain lion and an unidentified raptor. The fisher may be more susceptible to predation in areas with less forest cover and thus logging may expose them to additional risk (Buck et al. 1994).

VII. Overutilization for commercial or recreational purposes

Trapping of fishers for their fur was one of the primary causes for its decline across the United States in the first half of the twentieth century (e.g. Powell 1993). In response to concern over severe declines in number of fishers caught, legal trapping of fishers was prohibited in California in 1946 (Lewis and Zielinski 1996), in Washington in 1933, and in Oregon in 1937 (Lewis and Stinson 1998). Poaching and incidental capture and injury, however, remain threats to the fisher.

Lewis and Zielinski (1996) report that both California Department of Fish and Game biologists and trappers had information demonstrating occurrence of poaching and illegal sale of pelts. Fishers are easily caught in traps set for other furbearers, such as fox or bobcat (Powell and Zielinski 1994). Lewis and Zielinski (1996) estimated an incidental capture of 1 per 407 set-nights and a mortality-injury rate of 0-75%, based on data from trappers. Poaching or incidental capture can potentially affect fisher populations, even if it is a relatively rare occurrence. Powell (1979) predicted that mortality of as few as 1-4 fishers per 100 km^2 was sufficient to result in decline of a population in the Midwest. Lewis and Zielinski (1996) added:

> "The magnitude of the effect of additive mortality would depend on the sex and age of the captured individuals (Krohn et al. 1994), and may be greater in western populations since they have not demonstrated the rapid population recovery after protection that has been observed in eastern populations."

California and Washington have both recently banned leg-hold traps and snares by citizen initiative, which should help reduce risk of fisher injury or mortality with incidental capture. A similar measure is needed in Oregon. USDA and USDI (1994) recommended closing all national forests in the range of the northern spotted owl to trapping for American marten because of similarity of appearance of the two species, but this was not ultimately adopted in the Record of Decision for the Northwest Forest Plan.

Endangered Species Act protection for the fisher would provide substantial protection against poaching by imposing stringent fines and adding to the profile of the crime by making it a federal offense. A similar level of protection is not provided by any of the states. For example, punishment for illegally poaching a fisher in California is a misdemeanor and incurs a maximum fine of $1,000 and/or six months in jail (California Code of Regulations § 460 and California Fish and Game Code 12,002), whereas the same crime under the Endangered Species Act is a felony and incurs a maximum fine of $50,000 and/or one year in jail (16 U.S.C § 1540 (b)(1)).

VIII. Inadequacy of existing regulatory mechanisms

"Establishing the reasons for the precarious status of the fisher populations in the Pacific Northwest may not be as important in the short term as making people aware of the status and providing federal protection for the populations. That the populations appear

dangerously low should be sufficient to generate protection; discussions and research into the reasons should occur after protection. In our opinion, protection by the states of Washington, Oregon and California has not been sufficient to improve population status." (Powell and Zielinski 1994)

A. Regulations to protect fishers and their habitat on National Forest lands.

1. Present and proposed regulations governing management of National Forests in the Sierra Nevada fail to adequately protect the fisher or its habitat.

Because of isolation, small population size, and continued habitat loss due to both anthropogenic and stochastic factors, the fisher population in the southern Sierra is at risk of extinction (Lamberson et al. 2000, Truex et al. 1998). Lamberson et al. (2000), for example, concluded:

> "Theoretical implications of the effects of stochastic phenomenon on small populations suggest that unless fishers in the southern Sierra can maintain high vital rates (reproduction and survival), the population may face imminent extinction… Furthermore, the southern Sierra population has very low genetic diversity and this impoverishment may put it at additional risk. Without a source of immigrants from the north, the population in the southern Sierra cannot be 'rescued' or genetically enriched by new animals from other populations."

In light of this information, it is clear that any management plan for the Sierra Nevada must do two things to ensure the long-term survival of the fisher in the Sierra Nevada—maintain and enhance existing fisher habitat and facilitate the recolonization of fishers into the central and northern Sierra, connecting the two California populations. Indeed, Truex et al. (1998) concluded:

> "Long-term management of fisher habitat in California should aim to restore and recruit large structural elements necessary for resting and denning while maintaining stands with high canopy closure… Recolonization of the central and northern Sierra Nevada may be the only way to prevent fisher extinction in the isolated southern Sierra Nevada population."

A substantial obstacle that must be addressed before fishers in the southern Sierra can be reconnected with fishers in northern California are habitat bottlenecks in portions of the northern and central Sierra Nevada. In particular, portions of the Eldorado, Tahoe and Plumas National Forests are characterized by checkerboard ownership, leading to habitat fragmentation, and areas west of Yosemite National Park in the Stanislaus and Sierra National Forests have been negatively impacted by the combined effects of large fires and logging. For example, the Forest Service recently concluded that "the central Sierra Nevada is the most fragmented [region in the Sierra] with a high number of highway crossings and several areas burned by large, severe wildfires, sometimes occurring across multiple ownerships," adding that "in the central and northern Sierra Nevada, patterns of fragmentation and connectivity depend on management of private lands" (USDA 2000). Addressing these bottlenecks should be a priority of any management plan for the Sierra Nevada.

Regulations designed to protect the fisher and associated late-successional forests currently consist of "furbearer networks" designated on some of the Sierra Nevada national forests and "Interim Guidelines" to protect the California spotted owl. In addition, on May 5, 2000, the Forest Service issued a Draft Environmental Impact Statement (DEIS) to amend Sierra Nevada national forest plans, which proposes new guidelines to provide protection for late-successional forests and associated species, including the fisher (USDA 2000). Below, we discuss both the current and proposed guidelines in relation to their ability to safeguard the existing fisher population by maintaining existing habitat and to facilitate the recolonization of the fisher in a larger and more stable portion of their range, including the central and northern Sierra.

a. Current Forest Service regulations in the Sierra Nevada

To date, the Forest Service has failed to enact comprehensive and effective measures to protect the fisher and its habitat in the Sierra Nevada. Instead, current regulations consist of vague guidelines in some Forest Land and Resource Management Plans and a network of "habitat management areas" that lack effective guidelines to provide real protection for the fisher. Furthermore, guidelines to protect other species, such as the California spotted owl, do not adequately protect the fisher and its habitat.

Furbearer networks. Based on an extensive review of the literature and communications with furbearer biologists and at the request of the Regional Forester for California's national forests, Freel (1991) recommended establishment of fisher habitat management areas (HMAs). HMAs were to be large enough to support a fisher reproductive unit with one male home range and two adjacent female ones and to be connected to other HMAs via corridors of suitable habitat. In response to this report and concern over the status of the fisher and other furbearers, several Sierra Nevada national forests designed and established HMAs (Questionnaire from Lynn Sprague, Regional Forester, Pacific Southwest Regional Office USDA Forest Service to National Forests of the Sierra Nevada 1998). The HMA strategy is similar to the SOHA strategy developed for the spotted owl and thus has many of the same problems (see Thomas et al. 1990). Namely, isolated "pairs" of fishers surrounded by unsuitable habitat are unlikely to persist because as individual pairs are lost due to deterministic factors or demographic or environmental stochasticity, there is little chance that habitat will be recolonized, eventually leading to collapse of the entire population. Indeed, Bombay and Lipton (1994) in a review of the effectiveness of the Eldorado National Forest's fisher HMA network conclude:

> "Despite this analysis, it is not at all clear that a network of single-pair habitat areas, connected by riparian corridors, is a desirable way to manage habitat for fisher populations. Literature on minimum viable populations would seem to indicate otherwise."

Even if the HMA strategy were effective, however, the Forest Service has not consistently implemented it and has failed to enact effective measures to protect habitat within the HMAs. Only five of the Sierra Nevada national forests have developed a network and only three of these have incorporated standards and guidelines for their HMAs into their forest plans (Table 9). In general, these guidelines provide little direction for management of the HMAs and allow continued logging. Only the Lassen's plan restricts existing uses by only allowing salvage logging, which still can potentially degrade fisher habitat (USDA Lassen National Forest 1993). However, the majority of the Lassen's HMAs were placed in existing wilderness, meaning this guideline only applies to a small portion of the Lassen's timber base. Both the Sierra and Stanislaus allow continued logging in the HMAs with few specific restrictions to protect fisher habitat beyond vague statements like "maintain sufficient habitat" and some minimal requirements to retain some snags and logs. For example, management plans for two of the seven HMAs on the Sierra National Forest fail to contain guidelines strictly prohibiting logging that reduces canopy closure, stand size or other stand attributes below levels required by the fisher (Sorini-Wilson 1997, Styger 1995).

Considering that most forests acknowledged that they had difficulty finding sufficient high-quality habitat to create the HMAs and had to include poor quality habitat, this lack of regulation in the HMAs is particularly egregious. For example, the Lassen acknowledges that 33% of their HMAs consist of unsuitable habitat. Similarly, the Sierra National Forest management plan for the Browns Meadow HMA acknowledges that half of this HMA has road densities of 6 miles/mile^2, and half has road densities of 3 miles/mile^2, but fails to recommend that any roads be obliterated (Styger 1995). This is despite the fact that low capability fisher habitat should have road densities no more than 3 miles/mile^2 and that high capability habitat should have road densities no more than ½ miles/mile^2 (Freel 1991).

Table 9. Status of fisher habitat management areas in Sierra Nevada National Forests.

National forest	Developed fisher HMA network	Incorporated into Forest Plan	HMA management guidelines from the Forest Plan
Sequoia	No	N/A	N/A
Sierra	Yes	Yes	Continue existing uses when they do not preclude usage by the species. Permit limited yield logging utilizing salvage, sanitation and individual and group selection methods with some retention of snags and logs. Management plans developed for two of seven HMAs.
Stanislaus	Yes	Yes	Develop management plans. Permit low yield, uneven age logging with guidelines to retain some snags and logs.
Eldorado	Yes	No	Suggested guidelines never adopted.

Tahoe	Yes	No	N/A
Plumas	No	N/A	N/A
Lassen	Yes (HMAs tentatively identified)	Yes	Only allow salvage logging.

Beyond the HMAs, a few of the Sierra Nevada National Forests have guidelines to protect the fisher in their forest plans, including the Sierra, Inyo, and Tahoe National Forests. These guidelines are for the most part vague and ineffectual. For example, the Tahoe National Forest Land and Resource Management Plan (1990) states: "develop and implement silvicultural practices to maintain or improve furbearer habitats." To date, there have been no amendments to the plan incorporating any such practices and thus the Tahoe's plan contains no specific guidelines to protect fisher habitat. The Sierra National Forest plan is the only one with a firm guideline to protect the fisher, requiring protection of a 120 acre area around denning sites if in closed forest and a 500 acre area if in open forest. However, this requirement falls far short of protecting enough suitable habitat to support a viable, reproducing population of the fisher and other guidelines allow continued loss and fragmentation of habitat, including the Interim Guidelines to protect the California spotted owl.

Interim Guidelines to protect the California spotted owl. In 1993, the Forest Service enacted Interim Guidelines to protect the spotted owl that presumably offer some protection to the fisher and its habitat. The Guidelines include previously established "spotted owl habitat areas" (SOHAs), which protect 1,000 acre blocks of habitat around a portion of known owl sites; "protected activity centers" (PACs), which protect 300 acres around most owl locations; and matrix lands protection. In matrix lands, two tiers of guidelines apply. In "select strata," which are stands preferentially selected by the owl for nesting, roosting or foraging, one entry for timber removal is allowed, but cutting is limited to trees <30" diameter and must retain ≥40% canopy closure, up to eight snags per acre ≥ 30" diameter or a snag basal area of 20 sq. ft./acre, 10-15 tons per acre of the largest downed logs and 40% of the basal area in the largest live and cull trees. In "other strata," which also contains some stands used by the owl for nesting, roosting or foraging, the same guidelines apply, except canopy closure can be reduced below 40% and only 30% of the basal area must be retained in the largest trees.

Although providing protection for some of the characteristics of fisher habitat, the Guidelines fall short of providing full protection of the habitat attributes identified in studies as important to the fisher and thus are insufficient to maintain suitable fisher habitat. In addition, they do not provide the landscape-scale habitat protection required by the fisher.

Protections provided under the Interim Guidelines do not maintain fisher habitat requirements for canopy closure, multi-layered canopies, or stand size. Specifically, the Forest Service has determined that moderate quality habitat has at least 60% canopy closure and multi-layered canopies (Freel 1991) and other studies have determined that fishers generally rest in stands with canopy closure >80%. The Guidelines, however, allow logging to 40% canopy closure in "select" strata and 30% in "other" strata and fail to offer any protection for multiple-layered canopies, instead allowing logging of medium sized trees (20-30" DBH) that generally are a key component of a layered canopy. Such logging has led to further loss and fragmentation of fisher habitat. Furthermore, the Guidelines fail to set targets for maintaining contiguous stands across the landscape, failing to establish any minimum stand size or limits on fragmentation. This effectively allows remaining habitat on the landscape to be carved into ever smaller and smaller pieces. Considering that the Eldorado National Forest determined that the majority of fisher habitat found on the Forest is found in blocks less than 40 acres (Bombay and Lipton 1994) and that similar conditions exist on other national forests in the Sierra Nevada, this is a critical omission.

The Guidelines also fail to protect habitat sufficient to maintain a viable reproducing fisher population. Because the Guidelines were not designed for the fisher, they do not provide protection for individual fishers comparable to PACs or SOHAs. Thus, logging can occur within the same stand as a natal den or within the core habitat of a fisher home range. Further, the Guidelines fail to require that minimum levels of suitable habitat be maintained within fisher home ranges, effectively allowing logging that could denude enough habitat to make a home range unusable. For example, they could log within a home range where only 50% of the home range is in mature, closed conifer forest, even though this is considered the minimum to maintain low capability habitat (Freel 1991). Lastly, the Guidelines do not set limits on road construction or other causes of habitat fragmentation, even though the fisher is known to be highly averse to forest openings (Dark 1997, Freel 1991, Powell 1993, Rosenberg and Raphael 1986, Seglund 1995). In sum, the Interim Guidelines fail to provide adequate protection for the fisher or its habitat.

b. Proposed regulations governing national forests in the Sierra Nevada

Before discussing proposed protections in the Forest Service's DEIS to amend Sierra Nevada forest plans (USDA 2000), it is important to note that when considering whether or not to list a species, the Fish and Wildlife Service is not to consider promised or future management actions, but instead only the current management and status of the species. In numerous cases, the Fish and Wildlife has been forced by judicial action to reverse decisions not to list species because they relied on promised management actions, including decisions over the Barton Spring's salamander, Queen Charlotte goshawk, jaguar, Alexander Archipelago wolf and coho salmon. This is not merely a legalistic technicality. There is good reason for considering only the current management and status. States, Federal agencies and private interests can easily promise to protect and recover species in order to avoid or delay a listing that they consider potentially controversial, but there is no way of knowing whether they will follow through on their promises or whether their actions will result in recovery. To protect species from ongoing destruction, modification or curtailment of habitat or range, listing under the ESA is required while management actions are being tested. If it turns out promised management actions result in substantial recovery, then at that point they can be incorporated into a recovery plan for the species. Clearly, the fisher in the Sierra Nevada is experiencing ongoing habitat destruction that is placing it in danger of extinction and thus requires ESA protection, regardless of untested and promised management actions.

The DEIS includes two preferred alternatives, both of which propose specific guidelines to protect the fisher, as well as general measures to protect late-successional forest characteristics utilized by the fisher and other species. Following is a discussion of the effectiveness of these alternatives to protect fisher habitat and ensure viability of the fisher in the Sierra Nevada.

i. Alternative 6

This alternative proposes to establish 500 acre protected activity centers (PACs) around all known denning sites, where logging can only occur if associated with a research study or when the PAC is near development or in the urban interface. In the latter case, canopy closure can be reduced to 40%. Additional protections include designation of "old forest emphasis areas," riparian buffer zones and guidelines to retain large trees, snags and logs, multi-layered canopies and some canopy closure (Table 10). Although this Alternative provides more protection than currently afforded the fisher in the Sierra Nevada, it fails to fully protect fisher habitat, does not provide adequate protection for the southern Sierra population, does not provide adequate landscape-scale protection to ensure a well distributed viable population of fishers across the Sierra Nevada, and does not offer any specific measures to recover the fisher in the central and northern Sierra.

Failure to fully protect habitat. Alternative 6 allows the continued degradation of fisher habitat in the Sierra Nevada. For example, despite the fact that the Forest Service's own literature review determined that moderate to high quality fisher habitat is comprised of stands with canopy closure of 60-100% (e.g. Freel 1991) and that recent studies demonstrate that fishers in the southern Sierra generally rest and forage in stands with very high canopy closure (>80%) (Truex et al. 1998, Zielinski 1999), Alternative 6 still allows logging stands to as low as 30% canopy closure in dry forests, to as low as 50% canopy closure in moist forests and to 40% canopy closure in PACs near developed areas. It also allows continued removal of snags to as low as four/acre. This is despite the fact that snags frequently occur in higher densities than four/acre in response to natural disturbances, such as fire and insect outbreaks, and are at low levels compared to presettlement forests (Franklin and Fites-Kauffman 1996). Further, Alternative 6 fails to provide complete protection of multi-layered canopies in dry forests, even though this is a key component of fisher habitat. In sum, the guidelines proposed in Alternative 6 will allow the continued degradation of fisher habitat across the Sierra Nevada.

Table 10. Protection measures potentially benefiting the fisher under two Framework alternatives.

Protection for:	**Alternative 6**	**Alternative 8**
The fisher	500 acre PACs around denning sites. Mechanical treatments only for research, except when near development then can reduce canopy closure to 40%.	PACs same as 6, except can only reduce canopy closure to 60% near development. Creation of **southern Sierra Conservation Area**, where within 5 miles of any fisher detection vegetation treatments can only occur if part of research study on effects to fisher. Close roads if necessary.
Old Forest Emphasis Areas	27% of landscape. Prescribed fire and thinning conducted in no more than 30% of watershed.	40% of landscape, otherwise same as 6.
Large trees	**Westside:** retain all trees >30". **Eastside:** retain all trees >24"	same as 6
Canopy closure.	**Dry sites (P. Pine):** Maintain a mean of 40%, range of 30-80%. **Moist sites (mixed con):** maintain a mean of 70%, range of 50-80%.	In all existing stands with >70% canopy closure and trees >24", retain at least 70% canopy closure with 30% in trees >24" and 20% in trees 6-23.9". In all existing stands with >40% canopy closure and trees 11-23.9", maintain 50% canopy closure with 20% in trees >24" and 10% in trees 6-23.9".
Basal Area	No requirement.	In all portions of the landscape not covered by the above canopy closure requirements, retain 30% of basal area in largest trees.
Multi-layered canopy	**Dry sites:** retain 2 layers over 1/3 of landscape. **Moist sites:** retain multi-layered canopy	See above under canopy cover.
Snags	4 of the largest snags/acre in westside mixed con. 6 in red fir. 3 in eastside pine.	Same as 6.
Openings	.5-2 acres allowed not more than 10% of landscape.	No openings greater than 1 acre.
Riparian Areas	Buffers of 75-300 feet, where logging is prohibited, but roads and some construction ok.	Same as 6

Inadequate protection for the southern Sierra Nevada population. Alternative 6 clearly lacks sufficient protection to ensure the long-term survival of the fisher in the southern Sierra

Nevada, allowing continued degradation of habitat across substantial portions of the landscape. Under Alternative 6, 37% of the landscape in the southern Sierra would be open to intensive management (Table 11). Further, 500 acres protected in PACs is nowhere near the minimum amount of habitat required by fishers (Freel 1991, Truex et al. 1998, Zielinski et al. 1997a). Zielinski et al. (1997a) determined that male fishers on average had 6808 acre home ranges and females had on average 1246 acre home ranges. While these estimates of home range do not directly correspond with the minimum amount of habitat required by fishers, they do indicate that fishers require larger areas than 500 acres. In addition, Freel (1991) determined that in high capability habitat at least 6,000 acres was required to sustain a reproductive unit of fishers. Finally, the alternative fails to provide a system of interconnected reserves that would support a viable population of reproducing fishers. Because protected habitat in PACs, old-forest emphasis areas and other designations under Alternative 6 were not designed in a spatially explicit manner to ensure fisher viability, it is unlikely that they will ensure that individual fishers occur in close enough proximity with travel corridors to allow reproduction and genetic interchange. This in combination with the fact that the amount of protected habitat is very likely insufficient, indicates that Alternative 6 will not sustain the southern Sierra fisher population in the long-term.

Table 11. Proportion of grouped land allocations within the Southern Fisher Conservation Area. Analysis based on geographic information system files supplied by the Framework Team. Analysis limited to Forest Service lands.

	Proportion in Grouped Land Allocations		
	Alternative 5	Alternative 6	Alternative 8
General Forest	6%	37%	0%
Wilderness and Wild & Scenic Rivers	26%	26%	26%
Restricted Allocations (includes all others)	68%	37%	74%
Urban Wildland Intermix Zone	1%	13%	13%

Alternative 6 fails to ensure recovery of the fisher in the central and northern Sierra. The critical issue of restoring fishers to the central and northern Sierra receives virtually no attention in Alternative 6. The only language in the standards and guidelines for Alternative 6 relating to connectivity of fisher habitat is vague and discretionary, and fails to require that high quality fisher habitat be provided in a spatially explicit manner that will promote the fisher’s movement to, and recolonization of, the central and northern Sierra Nevada.[6] Indeed, habitat bottlenecks in the central and northern Sierra receive no special treatment under the preferred alternatives, no particular effort is made to protect the best remaining habitat or to ensure connectivity between suitable habitat via biological corridors or other land allocations and Alternative 6 wholly fails to address the impacts of private land management on the fisher or other environmental values. Based on the conclusion of Truex et al (1998) that recovery of the fisher in the central and northern Sierra is absolutely essential to survival of the species in the Sierra Nevada, this is a critical omission.

ii. Alternative 8

This alternative proposes to establish PACs with the same guidelines as Alternative 6, although canopy closure can only be reduced to 60% in developed areas. In addition, it would establish a "fisher conservation area" in the southern Sierra Nevada, where within five miles of any fisher detection, logging could only occur in association with research to study the effects on the fisher. This will provide fairly substantial protection for the fisher population in the southern Sierra Nevada. Alternative 8 also goes further towards protecting existing habitat across the Sierra with stricter restrictions on reduction of canopy closure and more requirements for maintaining multi-layered canopies (Table 5). Although Alternative 8 does a better job protecting the southern Sierra populations and prohibiting additional habitat degradation, there are still several loopholes that may allow habitat loss and like Alternative 6, it fails to ensure recovery of the fisher in the central and northern Sierra.

Loopholes that allow further habitat degradation. Alternative 8 requires maintenance of >70% canopy closure in stands with an average DBH >24" and existing canopy closure >70%, but potentially allows degradation of stands with an average DBH of 11-23.9" and >70% canopy closure to 50% canopy closure. If such stands contain residual large trees, they likely provide

[6] Alternative 6 states that project analysis will include "consideration of general forest linkages," including interconnection of suitable habitat with forests containing 40 percent or greater canopy closure. (DEIS, p. D-16 (Standard FC23)). However, this standard fails to specify how wide a connecting corridor must be, or what other structural elements (e.g., number and size of large trees and snags) would be necessary to facilitate fisher movement. Alternatives 6 and 8 also state that "a team of appropriate scientists will determine the criteria for mapping habitat

low to moderate quality habitat for the fisher and thus allowing degradation to a more open stand structure will allow further habitat loss and degradation. In addition, Alternative 8 has the same snag retention guideline as Alternative 6, and thus similarly allows removal of large snags critical to the fisher and other sensitive wildlife.

Alternative 8 may also allow additional loss and fragmentation of habitat by mandating research on the effects of logging on the fisher. Although clearly research on the habitat needs and the effects of habitat loss on the fisher is critical, past actions would suggest that the Forest Service may not carry out such a mandate in good faith. Specifically, the Forest Service utilized such a mandate to cut over 300 trees >30" DBH in the 10S18 Fuels Reduction project. Given that there is already a high degree of anthropogenic habitat loss and fragmentation on the landscape, there is no discernable justification for increasing these losses in order to study effects on the fisher. Instead, accurate mapping of current vegetation, as is mandated in Alternative 8, along with further studies of fisher demography in both disturbed and undisturbed areas should be sufficient. Further, the Forest Service has repeatedly recognized the critical need to maintain existing large trees and has mandated that management not remove such trees. Cutting more of these trees now for the sake of studying the fisher would be redundant while needlessly contributing to further endangerment. By failing to place restrictions on the kind of research projects that can occur in fisher habitat, including the fisher conservation area, Alternative 8 opens the door for possible abuse.

Alternative 8 similarly fails to ensure recovery of the fisher in the central and northern Sierra. Similar to Alternative 6, Alternative 8 fails to propose guidelines that will ensure recovery of the fisher in the central or northern. In particular, although the Alternative provides substantial protection for existing habitat by prohibiting cutting in stands with high canopy closure and large trees, it does not propose sufficient guidelines to facilitate recovery of currently unsuitable habitat, only requiring retention of 30% of the basal area in the largest trees in stands with canopy closure below 40%. It is unlikely that such retention would result in development of fisher habitat in a reasonable timeframe. Also like Alternative 6, Alternative 8 does not

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bottlenecks" for the fisher. (DEIS, p. D-64 (Standard OF 44). Yet there is no timeframe for such an analysis and no requirement that forest plans be amended to incorporate the team's findings and recommendations.

address habitat bottlenecks in the central and northern Sierra Nevada. Given that there is a recognized lack of suitable habitat in the central and Sierra Nevada, including significant habitat bottlenecks (e.g. Bombay and Lipton 1994, USDA 2000), maintaining existing habitat as proposed under Alternative 8 will not facilitate recovery of the fisher to the entire Sierra Nevada, which has been recognized as critical to its viability (Lamberson et al. 2000, Truex et al. 1998).

In sum, neither the current or proposed alternatives governing management of national forests in the Sierra Nevada establish sufficient guidelines to promote recovery of the fisher in the central or northern Sierra or ensure that there is sufficient contiguous habitat to facilitate this recovery, despite the fact that this has been determined to be necessary to the long-term viability of fishers in the Sierra Nevada.

iii. Sequoia National Monument

In a recent proclamation (April 15, 2000), President Clinton established the Giant Sequoia Monument, including 327,769 acres. This Monument will result in restrictions on logging and construction of new roads and thus will provide some protection for the fisher within its boundaries. However, timber sales already under contract or with Decision Notices signed in 1999 will go forward and hazard tree logging will continue to be permitted. In addition, a substantial portion of the fisher population occurs outside the monument boundaries. Only roughly 24% of all detections from track plate surveys conducted from 1989-1994 (Figure 2)(Zielinski et al. 1997a) occur within the Monument boundary. Finally, similar to the southern Sierra Conservation Area designated under Alternative 8, the Sequoia National Monument will not reconnect the fisher in the southern Sierra with northern California and thus will not ensure the long-term persistence of the fisher in the Sierra Nevada.

2. The Northwest Forest Plan fails to adequately protect the fisher or its habitat in northern California, Oregon and Washington.

Before considering the adequacy of the Northwest Forest Plan to protect the fisher, there are several general points about fisher biology and forest management in the Northwest to consider.

Populations of the fisher in its West Coast Range are isolated from the larger continental population and from each other. Recent genetic analysis indicates that gene flow historically occurred from British Columbia to the southern Sierra (Drew et al. in litt.) Such gene flow may be important to the long-term survival of the fisher on the West Coast. Thus, protection measures for the fisher must be considered within the context of their ability to facilitate recolonization of fishers in enough of their historic range in Washington and Oregon for gene flow to occur across populations. Protections for late-successional forests and associated species on both public and private lands in the Northwest were designed largely for the northern spotted owl, marbled murrelet and salmonids. Despite the fact that spotted owls, murrelets and fishers are all associated with late-successional forests and that we have used loss of such forests as a proxy for loss of habitat, as was done with the owl (USDI 1991), the degree to which the habitat needs of the owl, murrelet and anadromous fish overlap with the habitat needs of the fisher is undetermined and there is likely some divergence. For example, because both the marbled murrelet and the spotted owl have the ability to fly over areas of unsuitable habitat, they are likely less sensitive than the fisher to habitat fragmentation or dispersal barriers, such as major roads. As a result, reserve designs or protection measures designed around these species habitat needs are unlikely to facilitate recovery of the fisher to a larger and more stable portion of their range. Indeed, Lewis and Stinson (1998) concluded:

> "the preservation and management of older stands for northern spotted owls, marbled murrelets and protection of structure in riparian areas for salmonids in Washington may provide areas of suitable habitat for fishers in the future. However, fishers require larger areas than spotted owls, and may require more extensive habitat connectivity of closed-canopy stands.

Where fishers have been considered in management plans on private and public lands, it has generally been as an afterthought and specific measures to protect the fisher have generally not been enacted. The Northwest Forest Plan is no exception to this pattern.

On April 13, 1994, the Forest Service and Bureau of Land Management adopted the Northwest Forest Plan, which amended all planning documents to provide "management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl," including the fisher (USDA and USDI 1994). Unfortunately, the Plan fails to enact specific protections for the fisher, allows continued habitat degradation, and will do little to facilitate recovery of the fisher to a larger and more viable portion of its range.

a. Description of the Northwest Forest Plan

The Northwest Forest Plan had two primary objectives—protect late-successional forests and associated species and restart the federal timber program, which had been brought virtually to a halt by court orders (FEMAT 1993). To accomplish these goals, the plan created a system of land designations, including late-successional and riparian reserves, where logging is mostly prohibited, and matrix lands and adaptive management areas, where logging is allowed with some restrictions (USDA and USDI 1994).

In the late-successional and riparian reserves, logging is restricted to thinning in stands younger than 80 years old and salvage in any stand larger than 10 acres, where there has been a stand-destroying disturbance, such as a blowdown, fire or an insect outbreak. Approximately 30% of federal lands in the range of the northern spotted owl were placed in late-successional reserves and another 11% in riparian reserves. Riparian reserves are roughly 300 feet on both sides of fish bearing streams, 150 feet on both sides of perennial, non-fish bearing streams and 100 feet on both sides of intermittent streams.

In matrix lands, logging is allowed in stands of all ages, including late-successional forests, but 15% of the green-tree volume, 240 linear feet of logs per acre greater than 20" in diameter west of the Cascades, 120 linear feet of logs greater than 16" diameter east of the Cascades, and sufficient snags per acre to support cavity nesting birds at 40% of potential population levels (number per acre depends on forest type) must be retained. The restriction to retain 15% of the green-tree volume, however, does not apply in the Mt. Baker-Snoqualmie National Forest, where site-specific restrictions were to be developed, or the Oregon Coast Range and Olympic Peninsula, where protections for the marbled murrelet were believed adequate. Logging of mature or late-successional forests is prohibited in 100 acre areas around known spotted owl activity centers (drawn to include the best available habitat) and within .5 miles of any site occupied by marbled murrelets. In addition, logging of late-successional forests is prohibited where they occupy less than 15% of a watershed. Matrix lands were designated on 16% of federal lands in the range of the northern spotted owl and include 17% of remaining late-successional forests (USDA and USDI 1999).

Adaptive management areas, which comprise 6% of lands covered by the Plan, are open to logging, but only as part of experiments to "develop and test new management approaches" (USDA and USDI 1994 ROD).

Another 36% of federal acres in the range of the northern spotted owl are in congressionally withdrawn areas (30%), such as wilderness and national parks, and administratively withdrawn areas (6%), such as research natural areas. A majority of these areas, however, occur in high elevation forest types not utilized by the fisher.

b. The Northwest Forest Plan fails to enact provisions to protect occupied fisher habitat from logging or other activities.

The Northwest Forest Plan fails to classify the fisher as a "survey and manage" species (USDA and USDI 1994), meaning that the Forest Service is not required to survey for fisher before logging or conducting other activities. Furthermore, no protection is provided for fisher denning or resting sites, allowing the Forest Service to remove stands fisher may be using to raise young. Similarly, there are no requirements to protect habitat within fisher home ranges or to provide connecting habitat between fisher home ranges. Thus, if habitat utilized by individual fishers is protected it will only occur by accident through protection provided to the northern spotted owl or other species.

c. The Northwest Forest Plan fails to adequately protect late-successional forests and fisher habitat

As noted above, one of the primary goals of the Northwest Forest Plan was to restart the Federal timber program. Approximately 17% of remaining late-successional forests were placed in matrix lands and logging under the Plan is targeted towards these lands (USDA and USDI 1994 and 1999). USDA and USDI (1999), for example, concluded:

> "The PSQ [probable sale quantity] is heavily dependent on harvesting late-successional forests for 3 to 5 more decades until early-successional stands begin to mature and become available for harvest. Although only one-third of the 3.4 million acres suitable for harvest are late-successional forest, about 90% of PSQ over the next decade will be derived from harvest of late-successional forest."

Thus, the Northwest Forest Plan is dependent on liquidating remaining late-successional forests on matrix lands to meet sale volumes promised under the Plan. Indeed, a recent biological assessment to determine effects on listed species of logging in the Willamette Province, including the Mt. Hood and Willamette National Forests and the Eugene District of the Bureau of Land Management, determined that remaining habitat for the northern spotted owl on matrix lands would be entirely eliminated in 28 years (Byford et al. 1998). Considering that late-successional forests have declined by as much as 80% (USDI 1990) and that habitat is likely a limiting factor for the fisher in the Northwest (FEMAT 1993, Lewis and Stinson 1998), allowing loss of 17% of remaining late-successional forests is counter to the survival and recovery of the fisher on the West Coast. Powell and Zielinski (1994), for example, concluded:

> "Further reduction of late-successional forests, especially fragmentation of contiguous areas through clearcutting, could be detrimental to fisher conservation."

In addition, retention standards for logging are unlikely to benefit the fisher. Retained logs, snags and dispersed live trees are not sufficient to retain the properties of fisher habitat within cutting units because such units will not have high canopy closure or multiple canopy layers, which are key components of fisher habitat (e.g. Carroll et al. 1999, Dark 1997, Seglund 1995). Similarly, requirements to protect 100 acres of habitat around spotted owl activity centers and to retain 15% of green tree volume, 70% of which is required to be in aggregates greater than .2 hectares, are unlikely to provide any suitable habitat for the fisher in the short-term because fishers are unlikely to cross cut areas with low overhead cover to reach forest aggregates or spotted owl activity centers (Dark 1997, Rosenberg and Raphael 1986, Seglund 1995). Although retaining logs, snags and green trees will confer some of the characteristics of late-successional forest to developing stands following cutting, which was the basic intent, the Plan provides no guarantee that rotation lengths will be sufficient to allow development of suitable fisher habitat, including these structures. In addition, a substantial portion of the snags, logs and green trees will likely not persist to the age when suitable cover for foraging, resting and denning habitat has developed, making such structures nominal at best. The Plan also fails to provide assurances that once habitat has developed following cutting that it will occur in a spatially explicit manner to support resident fishers or dispersal of fishers to suitable habitat.

d. Protection of late-successional and riparian reserves is inadequate to ensure recovery of the fisher to a larger and more viable portion of their range in the Northwest

The late-successional reserves designated under the Northwest Forest Plan fail to provide substantial protection for the existing fisher population in northern California and are unlikely to facilitate recovery of the fisher to a larger portion of Oregon and Washington, which is necessary to alleviate the current isolation of the northern California population from the larger continental population.

Much of the highest quality fisher habitat is outside of the reserves either because these reserves are too high in elevation or because they contain logged forests. For example, Carroll et al. (1999) used a multivariate analysis of the habitat characteristics surrounding known fisher locations to develop a habitat model for northwestern California and southwestern Oregon that would predict the probability of fisher detection. According to this analysis, late-successional reserves only harbor 7.7% of the area with a high probability of fisher detection (>.67). Furthermore, wilderness areas only contain 2.8% and national and state parks only contain

12.2% of the area. Thus, only 23.7% of those areas most predicted to harbor fishers in northwest California and southwest Oregon are currently protected (Carroll et al. 1999). Of the remaining area, 65.9% is either tribal or privately owned and 11.4% is national forest matrix lands. Similarly in Oregon and Washington, protected federal lands, including late-successional reserves, occupy a fairly small proportion of the landscape within the primary elevational range utilized by the fisher (Aubry and Houston 1992). Aubry and Houston (1992) documented that 87% of all reliable fisher records were from below 1,000 m west of the Cascades in Washington. Federal lands, however, only occupy 20% of the landscape below 1,000 m and although 75% of these lands are protected, this amounts to only roughly 15% of the landscape below 1,000 m in Washington (Pacific Biodiversity Institute unpublished data). Similarly, in Oregon only 32% of the landscape below 1,000 m is in federal ownership and only about 21% is protected. Thus, fishers in northern California are far less likely to occur in areas where they will receive protection from logging, such as a late-successional reserve, and in Oregon and Washington most of the historic range of the fisher is outside federally protected lands.

Late-successional reserves also consist of large amounts of habitat that is probably unsuitable for the fisher because of logging. Only 42% of late-successional reserves and 29% of riparian reserves are currently dominated by medium to large conifers (>21" diameter)(USDA and USDI 1994), meaning that 60-70% of the reserves are dominated by young second growth or plantations and thus, are likely not suitable habitat for the fisher. In addition, salvage logging, as allowed in the late-successional reserves, will result in further degradation of existing late-successional forest. Snags formed by insect outbreaks, wind or other forces form an integral part of late-successional forests and quality habitat for the fisher, which uses snags for resting and denning (Aubry et al. 1996, Truex et al. 1998). Thus, allowing their removal is counter to the maintenance of quality fisher habitat and late-successional forests.

Finally, the late-successional reserves were not designed to ensure the survival and recovery of the fisher, nor were they analyzed to determine if they would serve this function. Thus, it is unknown whether or not the reserves will facilitate recovery of the fisher to a large enough portion of Oregon and Washington to reconnect populations in northern California with those in British Columbia or if the reserves will support a stable, well-distributed population of fisher.

To the contrary, given that late-successional reserves harbor a small portion of the current and potential fisher habitat in the Northwest, it is unlikely that they are sufficient to accomplish these goals and ensure the survival and recovery of the fisher in its West Coast range. Indeed, the fisher was rated as having a relatively low probability (63%) of having a stable, well-distributed population in Washington, Oregon and northern California by a panel of leading scientists (FEMAT 1993).

In sum, the Northwest Forest Plan allows the continued degradation of a substantial portion of remaining late-successional forests and fails to protect sufficient habitat to ensure the recovery and survival of the fisher in a stable and well-distributed portion of its historic range.

3. Other regulations governing national forest lands

The National Environmental Policy Act (NEPA) requires Federal agencies, including the Forest Service and the Bureau of Land Management (see below), to consider the effects of their actions on the environment, including sensitive species. However, it does not prohibit them from choosing alternatives that will negatively affect individuals or populations of the fisher. The National Forest Management Act (NFMA) regulations state that "Fish and Wildlife habitat shall be managed to maintain viable populations of existing native and desired nonnative vertebrate species in the planning area" (NFMA 36 C.F.R. §219.19), but 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 effects shall be prescribed" (36 C.F.R. §219.19(a)(1)).

B. Bureau of Land Management

BLM lands are scattered throughout the foothills of the Sierra Nevada. Beck and Gould (1992) estimated that in the Sierra Nevada there are approximately 68,500 acres of potentially suitable habitat for the California spotted owl on BLM lands (Beck and Gould 1992). Many of these acres are likely not fisher habitat, however, because the owl uses habitats not utilized by the fisher, such as low elevation riparian woodlands. 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 and recreation. The fisher has not been given any special management status on BLM lands in the Sierra Nevada, nor does the BLM routinely consider or mitigate the effects of its actions on the owl.

In the Pacific Northwest, BLM lands occupy roughly 2,367,000 acres in Oregon, an inconsequential amount in Washington and approximately 344,200 acres in northwest California. Thus, BLM lands have the greatest impact on conservation of the fisher in Oregon. Further, Oregon BLM lands generally occur at lower elevations than Forest Service lands, indicating a greater proportion are in the primary elevational range utilized by the fisher (Aubry and Houston 1992). Much of the Oregon BLM lands are concentrated in the southwestern part of the state and frequently occur in a checkerboard ownership pattern with private lands.

Like national forests in the range of the northern spotted owl, BLM lands are managed under the Northwest Forest Plan. In addition to the protections provided by this Plan, 640 acre diversity/connectivity blocks were established on BLM lands, where 25-30% of the area should be maintained as late-successional forest, rotations should exceed 150 years and 12-18 green trees per acre should be retained when cutting. On BLM lands outside of reserves, 15% retention is not required as on national forest lands. Instead, they only have to retain 6-8 green trees per acre. The same criticisms applied to the Northwest Forest Plan on national forests apply on BLM lands. However, because BLM lands in Oregon are found primarily in checkerboard ownership patterns, the necessity to design reserves in a spatially explicit manner to ensure continuity and availability of fisher habitat is even more critical. Lack of regulation on private lands has resulted in liquidation of most fisher habitat in squares adjacent to BLM land. As a result, any habitat provided by the Northwest Forest Plan may be unavailable to the fisher because of the fragmented distribution it is likely to occur in.

C. National Park Service

National parks in the West Coast range of the fisher include Kings Canyon/Sequoia, Yosemite, Lassen Volcanic, Redwood, Crater Lake, Mt. Rainier, Olympic and North Cascades. In general, management of these Parks is consistent with the maintenance of fisher habitat. However, significant portions of most of these Parks are above the elevational range utilized by the fisher (76% in Washington and 100% in Oregon of national park acres west of the Cascades are above 1,000 m according to analysis by Pacific Biodiversity Institute). The primary threats to fishers within National Parks are roads and recreation. For example, four fishers were killed by vehicles between 1992-1998 in Yosemite National Park (Chow, personal communication). Heavily used trails have the potential to fragment fisher habitat and disturb fishers. Currently, none of the Parks have specific management plans to ensure that fishers are not harmed by recreational use on roads, trails or otherwise.

D. Private lands

1. California

Because private lands comprise a significant portion of the fisher's range in the Sierra Nevada and northern California (Carroll et al. 1999, Verner et al. 1992), their management is critical to ensuring the presence of habitat for dispersal of individuals and that supports successful denning and foraging. As noted above, this is particularly true both of private lands on which fishers are currently found in the southern Sierra Nevada and northern California, as well as of private lands in the central and northern Sierra Nevada that are important to facilitating fisher dispersal between the two populations.

The primary body of regulation affecting management of this species on private lands, the California Forest Practices Rules (hereinafter cited as "the Rules"), allow significant alteration of fisher habitat and do not provide protection of elements essential to fisher habitat, such as large trees, snags and downed wood, and high canopy closure. The lack of direction to protect these habitat elements has resulted and continues to result in degradation and destruction of late successional habitat utilized by the fisher. 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 fishers.

In the following sections we discuss numerous ways in which the Rules are inadequate to provide for the fisher and its habitat. In support of this discussion, we reference a review of 416 timber planning documents that were submitted to the California Department of Forestry between 1990 and 1998. Timber planning documents were selected from 18 locations within the range of the fisher. Each location was described by an 8,000 acre circle. Any timber planning document that occurred partially or wholly within the 8,000 acre area was included in the analysis.

a. The Rules fail to recognize the fisher as a "Sensitive Species."

The Rules contain no explicit protection for the fisher, in part because it is not a designated sensitive species under the Rules. If this classification were given, the Board of Forestry would be required to "consider, and when possible adopt...feasible mitigation [measures] for protection of the species" that are based on the best available science (FPR, §919.12 (d)). Even if the fisher was designated as a sensitive species, however, protection of the species is not assured since the only real requirement is that the Board "consider" feasible mitigation measures and there is no requirement that mitigation measures be implemented. While designation as a sensitive species provides almost no real protection, lack of such designation means the fisher has no explicit protection whatsoever under state regulation.

b. The Rules provide no protection for den sites on private lands.

The Rules provide no protection for fisher denning sites. Protecting the den trees themselves as well as sufficient habitat to buffer the effects of disturbance are important to ensuring reproductive success (Campbell et al. 2000). Lamberson et al. (2000) demonstrate in a simple population growth model that both female survival and fecundity must be high for the fisher population to be stable in the southern Sierra Nevada, where the documented numbers of fishers are extremely low (Campbell et al. 2000), and only 7 den sites have been located on National Forest lands. Because there are so few fishers in the southern Sierra, the disruption of den sites and associated habitat would likely result in the extirpation of the species from the Sierra Nevada. Similarly, on the north coast, where low female survival is a cause for concern (Truex et al. 1998), failure to protect den sites is counter to maintaining a stable population.

c. Logging under the Rules results in degradation and destruction of critical features of habitat for the fisher.

Because the logging practices named in the Rules are focused on the use of methods to achieve maximum timber production, extensive depletion of fisher habitat has occurred and will continue to occur.

For all logging prescriptions under the rules that apply to the 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 fisher 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 den, rest, and forage sites of the fisher. Regeneration methods have resulted in the removal of key components of fisher habitat, such as large, old trees, multi-layered canopies, snags, and downed logs (Powell and Zielinski 1994) over a substantial portion of the private lands in the Sierra Nevada and north coast. Indeed, this is the clear intent of the Rules 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 (used in 51 of the 416 cases we reviewed), in which all of the stand is removed at once; seed tree regeneration, in which most 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 fisher habitat. In addition, regeneration methods result in significant reductions in canopy closure. This has the potential to severely degrade and/or destroy fisher habitat by reducing canopy closure to less than that selected by fishers, and by eliminating the multi-layered canopies that characterize this species' 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 trees appropriate for the future recruitment of large snags (Ohmann et al. 1994).

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 trees 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 fisher—large, old trees, snags, and dense, multilayered canopies. Verner et al (1992) found that traditional selection logging has resulted in depletion of large, old trees. Beardsley et al. (1999) affirm this in concluding that there are very few large trees on private lands. There is no reason to assume that selection logging on private landswould be more likely to result in maintenance of fisher 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 fisher (Powell and Zielinski 1994). From our review of 416 timber planning documents, it does not appear that commercial thinning is a dominant logging prescription in the areas reviewed. Of the 416 planning documents reviewed, only 28 utilized commercial thinning methods.

The sanitation/salvage method is one of the most commonly utilized prescriptions under exemptions to the timber planning 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 specific stocking levels. 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.

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 reviewed. These prescriptions appear to allow the destruction of key habitat components, as do the regeneration prescriptions described above.

In sum, the regeneration methods and intermediate harvest methods utilized are likely to be extremely destructive to critical characteristics of fisher habitat, including large trees and multilayered forest canopy. Without effective restrictions, logging conducted under these rules has destroyed and will continue to destroy and degrade fisher habitat over a significant portion of its range.

d. Logging operations exempt from stocking and analysis requirements are also likely to pose significant threats to habitat for the fisher.

The Rules exempt a number of logging operations from the Timber Harvest Planning process. Approximately 69 percent (287 out of 416) of the timber harvest documents we reviewed were in 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 percent 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 impacts to fisher den 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 fisher habitat.

In sum, the dead, dying and diseased exemption results in the degradation of important characteristics of fisher 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 within the range of the fisher, this lack of protection raises serious concerns about the effects of logging on fisher habitat. Coupled with the degradation and destruction of fisher habitat that is occurring under the THP process, current regulation of logging on private lands is clearly not adequate to protect the fisher from becoming endangered with extinction.

e. The Rules' requirement for mitigation of significant impacts to non-sensitive species fails to provide practical protection to the fisher or its habitat.

While the Forest Practices Rules provide no explicit protection of the fisher and its habitat, the Rules do require that where significant impacts to non-listed species may result, the forester "shall incorporate feasible practices to reduce impacts" (FPR §919.4, 939.4, 959.4). However, the Rules do not require surveys for the fisher, do not require identification of fisher habitat, and provide no information concerning possible thresholds over which impacts to fisher habitat or the species might be "significant." No explicit requirements or technology for assessing cumulative impacts exist. Thus, it is very unlikely that this requirement would result in significant additional protection for fisher habitat.

The Rules' provision to "incorporate feasible practices to reduce impacts" where significant impacts to non-listed species may result provides almost no protection for the fisher because impacts, significant or not, are not identified. Further, the Rules fail to identify what constitutes a significant impact, and reduction of impacts is optional, rather than required.

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 fisher.

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 successional 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 harvest documents within the range of the fisher that we reviewed, late-successional forests were mentioned in only 7 cases. Thus, out of the 2,366,753 acres of private land impacted by these timber harvests, only 728 acres of late successional forest habitat were identified.

The failure of timber harvest documents to identify impacts to fisher 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) and Bolsinger and Waddell (1993) 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. However, the Rules fail to provide guidance on what might constitute a significant reduction in late-successional forest habitat or require private landowners to sum losses of late-successional forests across ownerships. 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.

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 fisher habitat.

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

Although snags are an important component of fisher habitat and are important den and rest sites, 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 any snags would be retained in the remaining cases.

In sum, the Rules fail to require retention of a minimum number of snags 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 fisher. In practice, few timber harvest documents appear to require retention of snags.

h. Additional protections for the northern spotted owl and marbled murrelet in northern California fail to provide significant protection for the fisher

Under the California Forest Practice Rules, private landowners wishing to log within the range of the northern spotted owl must avoid "take" of an owl, which is defined as disruption or impairment of feeding, breeding or sheltering. Determination of take is made by the U.S. Fish and Wildlife Service based on a review of information on suitable habitat, owl locations, owl surveys in the project area and the planned harvest. A landowner can avoid a take determination by applying the following guidelines to any owl activity center within 1.3 miles of the project boundary: nesting habitat must be maintained within 500' of the activity center, sufficient roosting habitat must be maintained within 500-1,000' of the activity center to support roosting and provide protection from predation and storms, 500 acres of owl habitat must be provided within a .7 mile radius of the activity center, and 1,336 total acres must be provided within 1.3 miles of any activity center. Landowners can avoid U.S. Fish and Wildlife oversight of their Timber Harvest Plans if they develop a "spotted owl management plan," which requires the same retention standards outlined above except that all of the 1336 acres of habitat within 1.3 miles must be maintained as nesting or roosting habitat rather than foraging habitat. A landowner can also avoid Fish and Wildlife Service oversight of individual timber harvest plans by creating a "habitat conservation plan" (HCP). The Rules do not specify specific provisions to protect the marbled murrelet, instead specifying that if a project is likely to result in "take" of a murrelet then an incidental take permit from the U.S. Fish and Wildlife Service must be obtained.

Although studies indicate that spotted owls and fishers are associated with many of the same habitat characteristics, there is no guarantee that protecting owl habitat will provide substantial protection for the fisher. Indeed, because fishers require larger areas and are more sensitive to habitat fragmentation than owls (Lewis and Stinson 1998), habitat retained around owl activity centers may be unavailable to the fisher. Even this limited amount of protection, however, is not applied on many private lands in northern California. Instead, the largest industrial owners have opted to create "habitat conservation plans" (HCPs) and receive an incidental take permit from the U.S. Fish and Wildlife Service, allowing them to destroy late-successional forests surrounding owl activity centers and occupied murrelet habitat.

i. HCPs of the two largest private landowners in northern California provide little protection for the fisher

Both the Simpson Timber (450,000 acres) and Pacific Lumber Companies (200,000 acres) have adopted HCPs for lands under their management (PLC 1999, Simpson 1992). Neither of these plans contain specific provisions to protect the fisher. Instead, they both work under the assumption that protections for the northern spotted owl, marbled murrelet or anadromous fish will suffice to protect the fisher, despite lack of any data or analysis to support this claim. In particular, fishers were not surveyed or studied in conjunction with either plan and thus there is no basis for claims that habitat protected by either plan provides substantial benefit to the fisher.

Adopted in 1992, the Simpson HCP sets aside 39 parcels with an equal number of owl activity centers, totaling 13,242.5 acres. The parcels range in size from 61.3 to 2002.5 acres with a majority (27) under 300 acres. Considering that this acreage is divided into 39 parcels and that the HCP fails to designate travel corridors of suitable habitat between the parcels, much of this habitat will probably be unavailable to the fisher. Even if this same amount of acreage was protected in one single block, however, it would be unlikely to support a viable and well-distributed population of the fisher because the total acreage of the parcels only roughly equals the size of two male fisher home ranges (Truex et al. 1998). In exchange for protecting this limited amount of habitat, Simpson received permission to take 3-5 owl pairs per year for the next 30 years, meaning the retention standards for owl activity centers described above are waived. Based on the requirement to protect 1336 acres within 1.3 miles of all owl activity centers under the waived retention standards, protection for 30-50 owls could have resulted in protection of roughly 40,000-67,000 acres.

The Pacific Lumber Company's HCP requires sale of 7,400 acres to the United States Government to protect old-growth redwood trees, set aside of 7,728 acres for the marbled murrelet, riparian buffers, maintenance of 108 owl activity centers, retention of some structural components post-harvest and maintenance of 10% of each watershed in late-seral condition. Riparian buffers range from 30' on intermittent streams to 170' feet on fish bearing streams, of which 100' is off-limits to harvest and 70' is open to limited harvest. Retention standards include leaving 4.8 snags/acre >15" in diameter, four live cull trees, all live hardwoods >30" and two logs/acre >15" diameter and over 20' long.

Despite these protections, the Pacific Lumber HCP is unlikely to provide significant protection for the fisher because it allows continued habitat loss and fails to enact specific protections for the fisher, besides future monitoring. The HCP allows logging of a substantial portion of remaining late-successional forest on their lands. Of an estimated 26,147 acres of old-growth (12% of their total lands), 57% is available for harvest (USDI et al. 1999). It also allows Pacific

Lumber to take 37 owl territories and provide minimal protection for 28 more, meaning the retention standards for activity centers described above are waived. Similar to the Simpson HCP, the total protected acreage (15,128 acres) is small compared to the home range requirements of the fisher, there is no guarantee the habitat is currently or will be utilized by the fisher and travel corridors were not designated to ensure availability of habitat for the fisher. Finally, retention of snags, live trees, large hardwoods and logs will retain some of the characteristics of quality fisher habitat. Because the HCP lacks a provision that these stand characteristics be retained in stands with suitable canopy cover in a spatially explicit manner to facilitate their use by fishers, however, there is no reason to believe that the HCP will ensure the continued existence of the fisher on Pacific Lumber lands.

j. Conclusion

Few or none of the logging prescriptions described in the Rules would result in retention of habitat features critical to the maintenance of fisher populations on private land. As previously discussed, logging practices within the range of the fisher 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 fisher, provide no effective measures to protect fisher habitat in any meaningful quantity and fail to provide a mechanism for identifying individual or cumulative impacts to the fisher or its habitat on private lands. Finally, there is no evidence to support claims that protections for the northern spotted owl, marbled murrelet or anadromous fish are sufficient to protect the fisher. The net result is that the Rules do not regulate logging on private lands in a manner that is adequate to maintain fisher habitat or populations on private land within California.

2. Oregon.

Because 46% of productive forests in western Oregon are privately owned, including a majority of the most productive low elevation lands (Gedney 1982, Bolsinger and Waddell 1993), they are important to the recovery and survival of the fisher. Unfortunately, lack of regulation in the past has allowed the liquidation of most late-successional forests on private lands in Oregon (Bolsinger and Waddell 1993) and current regulations are unlikely to result in substantial habitat recovery, particularly given the fact that Oregon's forest practices rules are considerably weaker than California's.

Similar to California, Oregon's forest practices rules contain no provisions to specifically protect the fisher, allowing logging of occupied denning, roosting and foraging habitat. Clearcutting is clearly the preferred method of logging in Oregon and the state's rules provide very few restrictions to this logging. The only restrictions are that clearcuts can be no larger than 120 acres, except in special cases, at least two snags or green trees/acre >11" diameter and two downed logs/acre >6' long with a gross volume of 10 cubic feet must be retained, logging is prohibited within 20' of most streams and retention of a portion of the basal area is required within 20-100' depending on the size of the stream and whether or not it is fish bearing. In addition, 70 acres must be protected around all owl activity centers.

The rules clearly do not preserve key components of fisher habitat, such as large trees, snags and logs, multi-layered canopies and high canopy closure (Carroll et al. 1999, Dark 1997, Seglund 1995, Truex et al. 1998). Although they require retention of two trees or snags per acre, they only have to be 11" in diameter and there is no protection to ensure that they will not be cut in the next rotation. The rules allow clearcutting, which results in the removal of fisher habitat (Lewis and Stinson 1998) and fail to specify a rotation length, meaning that fisher habitat may never be allowed to develop. Thus, Oregon's forest practices rules fail to enact substantial protections for the fisher or its habitat.

To date, one large HCP, covering Weyerhaeuser's 209,000 acre Millicoma Tree Farm in southwestern Oregon, has been enacted for private lands in Oregon (Weyerhaeuser 1995). Similar to the Forest Practices Rules, the Weyerhaeuser HCP provides very little protection for fisher habitat, only requiring that 40% of the tree-farm be managed as dispersal habitat for the spotted owl. Under the HCP, dispersal habitat consists of 22-30 year old stands with an average DBH of 10-12". Such stands are unlikely to be utilized by the fisher. The Plan also protects 1,187 acres of spotted owl nesting, roosting and foraging habitat around eight activity centers. Because this habitat will occur in small, widely dispersed patches in a landscape dominated by clearcuts and young plantations, however, it is unlikely that it will facilitate recovery and survival of the fisher on the Millicoma Tree Farm or surrounding lands.

3. Washington.

Roughly, 50% of all productive forest lands in Washington are privately owned. If western Washington is considered alone, 60% of the productive forest lands, encompassing the most productive forests at low elevations, are privately owned (Bolsinger et al. 1992). Thus like Oregon, private lands in Washington are essential to the recovery and survival of the fisher.

Washington's forest practices rules are similar to Oregon's. Clearcuts are limited to 120 acres in size with exceptions given up to 240 acres. In all cutting units, three wildlife reserve trees (>12" diameter), two green recruitment trees (>10" diameter, 30' in height, 1/3 of height in live crown) and two logs (small end diameter>12", >20' in length) must be retained. A portion of trees must be left in "riparian management zones," which range in size from 25-100' depending on the size of the stream and whether or not it is fish bearing (WAC 222-30). Finally, 70 acres of habitat must be protected around all known owl activity centers. Like Oregon, Washington's forest practices rules fail to preserve key components of fisher habitat or to enact substantial protections to allow habitat recovery.

The fisher is listed as a state endangered species (WAC 232-12-297), but this conveys little protection for the fisher on private or state lands. The only requirement for state endangered species is that Washington Department of Fish and Wildlife prepare a recovery or management plan within five years of listing. For the fisher, a plan is not due until 2003. Even if there already were already had a plan, however, there is no guarantee this would provide strong protection for fisher habitat. According to WAC 232-12-297, recovery plans can call for regulation, mitigation, acquisition, incentive, and compensation mechanisms as approaches to meet recovery objectives, but these measures must be "sensitive to landowner needs and property rights." This means that private landowners will only be asked to protect fisher habitat if it is of no inconvenience or does not result in any financial cost. In addition, there is no guarantee that if a recovery plan called for substantial management that there would be funding for such management.

Two large HCPs have been enacted in Washington, including one by Plum Creek, covering 418,690 acres in the I-90 corridor and another by Simpson Timber Company, covering 261,575 acres on the southern Olympic Peninsula (Simpson Timber Company 2000, Plum Creek 199?). Relatively similar, these HCPs provide little protection that will benefit the fisher. Neither timber company considered the fisher in development of its HCP or provided specific protections for the fisher or its habitat. Protections in both consist of a prohibition on logging within roughly 10 m on fish bearing streams, limitations on logging on other streams and within a wider area (up to 60 m) on fish bearing streams, minimal tree retention standards in cutting units and protection of a limited number of widely dispersed acres for either the northern spotted owl or marbled murrelet. These protections are unlikely to result in a sufficient quantity of habitat dispersed in a manner to support a viable and reproducing population of the fisher either on lands covered by the HCPs or on adjacent federal lands.

E. State lands

1. California.

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). Recreation is the main threat to fishers 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 fisher 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 the fisher 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 fisher. Similarly, state forests in northwestern California comprise a small overall area in widely spaced parcels that are not managed to maintain late-successional characteristics.

2. Oregon.

There are currently two management plans governing management of Oregon state forests. The recently completed (September 2000) final draft of the "Northwest Oregon State Forests Management Plan" will govern management of 615,000 acres of state land in Northwest Oregon, including portions of the Coast Range and Cascades[7] and the "Elliot State Forest Habitat Conservation Plan" will govern management of the 93,000 acre Elliot State Forest in southwest Oregon.

Proposed protections under the northwest Oregon plan include managing an unspecified 25% of the landscape for "old forest structure," and retaining an average of five green trees per acre, all snags that are safe to leave, and a minimum of two logs >24" dbh where available or 600-900 cubic feet per acre of sound down logs after harvest by clearcut. In addition, the plan will create riparian management areas where within 25' of most streams harvest is prohibited, within 25-100' of all fish bearing and medium and large non-fish bearing streams management should encourage development of mature forest condition, and within 100-170', depending on size and presence of fish, 0-45 trees will be retained.

These protections are unlikely to create sufficient late-successional habitat, which the plan admits is extremely limited on state lands in northwest Oregon, to support a stable population of fishers. The requirement to manage 25% of state lands for old forest structure is unlikely to significantly benefit the fisher because the plan specifies that these lands be designated at the district level, almost guaranteeing that they will occur in small, widely spaced parcels. Furthermore, none of the other protections are likely to create large blocks of forest that meet the

[7] According to numerous court decisions, the U.S. Fish and Wildlife Service is not to consider untested management actions in draft or recently completed plans when evaluating the adequacy of existing regulations to protect an imperiled species. We discuss proposed management in this plan only to provide the most updated information possible.

basic habitat requirements of suitable fisher habitat, such as a predominance of large trees, snags and downed logs, high canopy closure and multi-layered canopies.

In contrast to northwest Oregon state lands, where most habitat has already been eliminated, the 93,000 acre Elliot State Forest still has a fair amount of existing habitat. According to the Elliot HCP, roughly 51% of the forest is older than 80 years, much of which has naturally regenerated from an 1868 fire. Many of the stands that date to this fire retain elements of old-growth forests that survived the fire, such as large trees and snags. However, there has also been a substantial amount of clearcutting in the last 35 years, resulting in habitat fragmentation. If existing habitat were left in tact and additional areas were allowed to recover, the Elliot could be used as a building block for reintroducing the fisher into the heavily impacted Oregon Coast Range, particularly given the Elliot's proximity to large wilderness in the Siskiyou Mountains where fishers have been sighted. Unfortunately, the HCP squanders this opportunity, allowing continued loss of forest with late-successional characteristics.

Like many Northwest HCPS, the Elliot State Forest HCP was primarily designed for the spotted owl and marbled murrelet and provides little analysis of or protection for other species, including the fisher. It would place roughly 18,060 acres or 19% of the forest in reserves for spotted owl, murrelet, salmon and other uses, such as scenic conservancy. Outside of reserves, the plan primarily manages the forest by specifying rotation lengths of 80 to 240 years with an average of 151 years. Under this regime, stands over 76 years will decline for the first 40 years of the plan then level off and increase to slightly lower than their present distribution in 100 years, provided there are not other disturbances, such as fire (an unlikely prospect). In total, the plan allows harvest of 22,075 acres (23.7% of the forest and greater than 50% of existing older stands) of stands greater than 80 years old in the next 60 years and thus allows substantial loss of forests with late-successional characteristics, particularly in the short-term. Such loss is not conducive to the recovery of the fisher in the Elliot State Forest or the Oregon Coast Range.

3. Washington.

Comprising roughly 1.6 million acres of forest, Washington State lands occupy a substantial portion of the fisher's historic range in the state. Because these lands generally occur at lower elevations than National Forest lands, a higher proportion is within the elevational range preferred by the fisher (Aubry and Houston 1992, DNR 1997). Thus, state lands are important to the survival and recovery of the fisher. The Washington Department of Natural Resources (DNR), which oversees management of all state lands, recently developed a multi-species habitat conservation plan (DNR 1997). Over half of all DNR forests are under 60 years in age and less than 150,000 acres are over 150 years, indicating most old-growth on Washington State lands has been liquidated (DNR 1997).

As with all of the other regulations covering management of forests in the Pacific Northwest, this HCP primarily relies on protections for northern spotted owls, marbled murrelets and anadromous fish to protect the fisher. The HCP does prohibit cutting or other activities within .5 miles of fisher den sites during the breeding season, but because the Plan does not require surveys for fishers and allows these activities in the non-breeding season, this affords the fisher very little protection.

Protections for the spotted owl consist of establishment of 202,000 acres of "nesting, roosting and foraging (NRF) management areas" and 200,000 acres of "dispersal management areas." Within NRF areas, 50% of the landscape must be maintained in nesting, roosting and foraging habitat. Logging is allowed within the 50% protected area, but must maintain sub-mature habitat. Sub-mature habitat is characterized by at least 70% canopy closure and 115-280 trees/acre, including three snags or cavity trees >20" diameter. In addition, two 500 acre blocks of habitat must be maintained per 5,000 acres, of which 300 acres must be high quality nesting habitat. Within dispersal areas, 50% of the landscape must be maintained in habitat with at least 70% canopy closure, a quadratic mean diameter of at least 11" and four trees/acre from the largest size class must be retained. Thus, the HCP provides some level of protection for 201,000 acres or roughly 12.5% of their forested lands.

For the marbled murrelet, the HCP adopted an interim plan, in which logging is prohibited in contiguous stands of >5 acres where murrelets have been documented to occupy the stand.

Called suitable habitat blocks, these areas will remain off-limits until the DNR studies the habitat relationships of the murrelet and devises a new strategy. For anadromous fish and other riparian species, logging is prohibited with 25' of streams, limited to selective cutting within 25-100' and large fish bearing streams limited to individual or group selection between 100-150'. Finally, five live trees and three snags/acre will be retained on all cutting units. One of the live trees must belong to the largest diameter class, another must be in the dominant crown class and snags should generally be >20" diameter and 40' tall. Outside of protected areas, logging is governed by the same regulations discussed above for private lands.

Since these protections were designed for the northern spotted owl, marbled murrelet and anadromous fish, there is no guarantee they will provide sufficient habitat to support recovery of the fisher in Washington. The DNR did not conduct additional analysis or collect data to determine if protected habitats will be of use to fishers. In the majority of the NRF management areas, the DNR is only required to maintain sub-mature habitat. There are no current studies indicating the fisher will survive and reproduce in such stands. Similarly, there are no studies documenting that fishers will disperse in habitats designated for this purpose. The limited areas where high quality nesting habitat must be maintained (600 acres in every 5,000) are likely to be widely dispersed and may be unavailable to fishers because of habitat fragmentation. Because they are smaller and are allocated based on murrelet locations, the marbled murrelet management areas are even less likely to be of use to the fisher.

A major loophole in the HCP is that it fails to provide complete and permanent protection for any stand. Logging can occur in the 50% protected habitat in NRF or dispersal areas and these protected areas do not have fixed boundaries. Thus, a stand that contributes to the maintenance of 50% sub-mature habitat in a NRF can be replaced with another stand and logged. As a result, the Plan will not appreciably increase the amount or distribution of late-successional forest on the landscape. Indeed, according to the HCP, stands older than 150 years will increase by less than 10,000 acres by 2046, suggesting the Plan will fail to result in a substantial increase in fisher habitat on DNR lands.

Finally, retention standards for riparian areas and cutting units will not preserve sufficient stand components to retain fisher habitat following cutting. While they may incur some structure to young regenerating stands, it is not clear from the Plan that such stands will be allowed to develop into fisher habitat or that if they are, this habitat will occur in large enough blocks and in an appropriate distribution to support a viable population of fishers.

In addition, the State of Washington recently listed the fisher as a state endangered species. This designation, however, provides very little real protection for the fisher. Say more here.

F. Tribal lands

Information on the status and management of the fisher or its habitat on Native American lands is limited. We were only able to obtain information on the 360 km^2 Hoopa Valley Indian Reservation. Located near the center of the fisher's range in northern California, this reservation provides important habitat for the fisher (Carroll et al. 1999). In part because the fisher is of ceremonial importance to the Hupa people, the Tribe has been researching the status of the fisher on the reservation (Higley 1998). Research has included radio-collaring 16 fishers, locating resting and denning sites and measuring habitat. In addition, the Tribe recently enacted a forest management plan, including some protection for the fisher (Tribal Forestry 1994).

In evaluating the Hoopa Valley Indian Reservation's Plan, we recognize that the Tribe is a Sovereign Nation. We are providing the following analysis not because we think a different management regime or regulations should be imposed on the Tribe, but because management of the fisher and its habitat on the Reservation is important within the larger context of survival and recovery of the fisher on the West Coast.

Unlike any of the HCPs in the West Coast range of the fisher, the Tribe's Plan specifically prohibits forest activities from "knowingly" resulting in "take" of a Tribal species of special concern, including the fisher, without approval from the Tribal Council. However, because the Plan does not define what constitutes take or specifically prohibit activities that will result in take, it is unclear what protection this provision provides. The Plan, for example, does not specifically prohibit logging within fisher denning or resting stands, which would result in take, as defined under the Endangered Species Act.

Otherwise, the Plan places 34,468 acres off-limits to logging, limits harvesting on 23,438 acres to group or single tree selection or shelterwood without overstory removal, and allows intensive timber management using a modified clearcut prescription on 36,151 acres. Under all of the above harvesting prescriptions, the goal is an 80 year rotation. Clearcuts are limited to 10 acres and must retain two-five trees and 100 cubic feet of downed wood should be left in pieces 20 cubic feet or larger. Under the shelterwood prescription, 8-14 overstory trees/acre should be retained. Retained trees, however, can be cut after 80 years. Under the group selection prescription, cutting patches are limited to two acres.

Although the Tribe's Plan sets aside a considerable portion of the Reservation, it is currently unknown whether or not this habitat is sufficient to support a viable and well distributed population of the fisher on the Reservation or in the region. All of the prescriptions will result in the continued removal of elements of late-successional forest, such as large trees, snags and logs, and high canopy closure and thus will allow for continued loss and fragmentation of fisher habitat. It is unknown to what extent 80 year old stands, which is the target rotation, provide habitat for foraging, resting or denning fishers on the Hoopa Valley Indian Reservation. In sum, although considerably more restrictive than any regulations on private lands, it is unclear to what extent the Tribe's Plan will maintain the fisher.

IX. Conclusion

A combination of trapping, logging and other factors has resulted in a significant diminution of the fisher's range on the West Coast (Aubry and Houston 1992, Zielinski et al. 1997a). Remaining populations in the southern Sierra and northern California represent the only surviving native populations of the species in the western United States. These populations are at risk because of a combination of continued habitat destruction caused by logging and development, poaching, predation, small population size and population isolation (Aubry and Houston 1992, Lewis and Stinson 1998, Powell and Zielinski 1994, Truex et al. 1998). Current regulations fail to provide substantial habitat protection or to facilitate recovery of the fisher to a larger and more stable portion of its historic range on the West Coast. Finally, because it is discrete and significant, the West Coast population of the fisher meets the definition of a distinct population segment. All of these factors indicate the fisher merits federal protection under the Endangered Species Act.

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References

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

Anderson, E. 1994. Evolution, prehistoric distribution, and systematics of *Martes*. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 13-25). Ithaca, NY: Cornell University Press.

Arthur, S. M., and W. B. Krohn. 1991. Activity patterns, movements, and reproductive ecology of fishers in southcentral Maine. Journal of Mammalogy, 72, 379-385.

Arthur, S. M., W. B. Krohn, and J. B. Gilbert. 1989. Home range characteristics of adult fishers. Journal of Wildlife Management, 53(3), 674-679.

Arthur, S. M., T. F. Paragi, and W. B. Krohn. 1993. Dispersal of Juvenile Fisher in Maine. Journal of Wildlife Management, 57, 868-874.

Aubry, K. B., and D. B. Houston. 1992. Distribution and status of the fisher (*Martes Pennanti*) in Washington. Northwestern Naturalist, 73, 69-79.

Aubry, K. B., J. C. Lewis, and C. M. Raley. 1996. Reintroduction, current distribution, and ecology of fishers in southwestern Oregon: a progress report : USDA Forest Service Pacific Northwest Research Station.

Aubry, K. B., C. M. Raley, T. J. Catton, and G. W. Tomb. 1999. Ecological Characteristics of Fishers in Southwestern Oregon (Progress Report): USDA Forest service Pacific Northwest Research Station.

Badry, M. 2000. Furbearer specialist, Government of British Columbia, Ministry of Environment, Land and Parks, Wildlife Branch. Personal communication.

Bailey, R. G. 1995. Descriptions of the ecoregions of the United States (Webpage found at www.fs.fed.us/land/ecosysmgmt/ecoreg1_home.html): USDA Forest Service.

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. Gould. Jr. 1992. Background and the current management situation for the California spotted owl. In J. Verner, K. S. McKelvey, B. R. Noon, R. J. Gutierrez, 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.

Beckwitt, E. 1990. Petition for a Rule to List the Fisher as Endangered. North San Juan, CA: Central Sierra Audubon Society.

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.

Beyer, K. M., and R. T. Golightly. 1996. Distribution of Pacific fisher and other forest carnivores in coastal northwestern California . Arcata, CA: Humboldt State University.

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

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.

Bolsinger, C. L., N. McKay, D. R. Gedney, and C. Alerich. 1997. Washington's Public and Private Forests (Resource Bulletin PNW-RB-218): USDA Forest Service Pacific Northwest Research Station.

Bolsinger, C. L., and K. L. Waddell. 1993. Area of Old-Growth Forests in California, Oregon, and Washington (Resource Bulletin PNW-RB-197): USDA Forest Service Pacific Northwest Research Station.

Bombay, H., and D. Lipton. 1994. Biological evaluation of the habitat requirements for fisher on the Eldorado National Forest in relation to twenty-four sold timber sales : USDA Forest Service Eldorado National Forest.

Bouldin, J. 1999. Twentieth-Century Changes in Forests of the Sierra Navada, California. Unpublished Dissertation, University of California, Davis.

Buck, S., C. Mullis, and A. Mossman. 1983. Final Report: Corral Bottom-Hayfork Bally fisher study . Arcata, CA: Humboldt State University and USDA Forest Service.

Buck, S. G., C. Mullis, A. S. Mossman, I. Show, and C. Coolahan. 1994. Habitat use by fishers in adjoining heavily and lightly harvested forest. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 368-376). Ithaca, NY: Cornell University Press.

Buskirk, S. W., and R. A. Powell. 1994. Habitat ecology of American martens and fishers. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 297-315). Ithaca, NY: Cornell University Press.

Byford, K., E. Greenquist, R. Larson, W. Logan, J. Millman, B. Otani, and D. Pengeroth. 1998. Habitat Modification: Biological Assessment for Effects to Listed Species (Habitat Modification): The Willamette Province.

Campbell, L. A., W. J. Zielinski, and D. C. Macfarlane. 2000. A risk assessment for four forest carnivores in the Sierra Nevada under proposed forest service management activities (Unpublished Report): USDA Forest Service Sierra Nevada Framework Project.

Carlton, J. 1994. Petition to list the fisher as an endangered species in the western United States: Biodiversity Legal Foundation.

Carroll, C., W. J. Zielinski, and R. F. Noss. 1999. Using presence-absence data to build and spatial habitat models for the fisher in the Klamath Region, U.S.A. Conservation Biology, 13(6), 1344-1359.

Coulter, M. W. 1966. Ecology and management of fishers in Maine. Unpublished Ph.D. Thesis, Syracuse, NY, Syracuse, NY.

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. 1997. A landscape-scale analysis of mammalian carnivore distribution and habitat use by fisher. Unpublished Masters Thesis, Humboldt State University, Arcata, CA.

DNR. 1997. Final Habitat Conservation Plan: Washington State Department of Natural Resources (WA DNR HCP).

Drew, R. E., J. G. Hallett, K. B. Aubry, K. W. Cullings, S. M. Koepf, and W. J. Zielinski. in litt. Conservation genetics of the fisher, *Martes pennanti*, based on mitochondrial DNA-sequencing. .

Duane, T. P. 1996a. Human Settlement 1850-2040. In W. R. 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 W. R. 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.

FEMAT. 1993. Forest Ecosystem management: An Ecological, Economic, and Social Assessment (Report of the Forest Ecosystem Management Assessment Team).

Franklin, J. F. 1996. Working Group on Late-Successional Conservation Strategies. In W. R. Center (Ed.), *Sierra Nevada Ecosystem Project, Final Report to Congress, Addendum, Assessments and Scientific Basis for Management Options.* : University of California, Davis.

Franklin, J. F., and C. T. Dyrness. 1988. Natural Vegetation of Oregon and Washington: Oregon State University Press.

Franklin, J. F., and J. A. Fites-Kaufmann. 1996. Assessment of late-successional forests of the Sierra Nevada. In W. R. 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.

Freel, M. 1991. A literature review for management of the marten and fisher on National Forests in California : USDA Forest Service Pacific Southwest Region.

Frost, H. C., W. B. Krohn, and C. R. Wallace. 1997. Age-specific reproductive characteristics in fishers. Journal of Mammalogy, 78(2), 598-612.

Gedney, D. R. 1982. The Timber Resources of Western Oregon-HIghlights and Statistics (Resource Bulletin PNW-97): USDA Forest Service Pacific Northwest Forest and Range Experiment Station.

Gedney, D. R., P. m. Bassett, and M. A. Mei. 1986a. Timber Reseource stattistics for non-federal forest land in Northwest Oregon (Resource Bulletin PNW-RB-140): USDA Forest Service Pacific Northwest Research Station.

Gedney, D. R., P. M. Bassett, and M. A. Mei. 1986b. Timber resource staistics for non-federal forest land in Southwest Oregon (Resource Bulletin PNW-138): USDA Forest Service Pacific Northwest Research Station.

Gedney, D. R., P. M. Bassett, and M. A. Mei. 1987. Timber resource statistics for nonfederal forest land in West-Central Oregon (Resource Bulletin PNW-RB-143): USDA Forest Service Pacific NOrthwest Research Station.

Goldman, F. A. 1935. New American mustelids of the genera *Martes*, *Gulo*, and *Lutra*. Paper presented at the Proceedings Biological Society of Washington, 48.

Gould, G. I. 1987. Final Report: Nongame Wildlife Investigations, Forest mammal survey and inventory (Project No. W-65-R-4, Job No. IV-11). Sacremento, CA: California Department of Fish and Game.

Grenfell, W. E., and M. Fasenfest. 1979. Winter food habits of fishers, *Martes pennanti*, in northwestern California. California Fish and Game, 65, 186-189.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. Fur-bearing mammals of California. Berkely, CA: University of California Press.

Hagmeir, E. M. 1959. A re-evaluation of the subspecies of fisher. Canadian Field-Naturalist, 73, 185-197.

Hanski, I., and A. Moilanen. 1996. Minimum Viable Metapopulation Size. The American Naturalist, 147(4), 527-540.

Higley, J. M. 1998. Hoopa Valley Indian Reservation fisher study (Progress report): Hoopa Valley Tribe.

Jones, J. L. 1991. Habitat Use by fishers in northcenal Idaho. Unpublished Master's Thesis, Humboldt State University, Arcata, CA.

Jones, J. L., and E. O. Garton. 1994. Selection of successional stages by fishers in north-central Idaho. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 377-388). Ithaca, NY: Cornell University Press.

Kelly, G. M. 1977. Fisher (*Martes pennanti*) biology in the White Mountain National Forest and adjacent areas. , University of Massachusetts, Amherst, MA.

Kilgore, B. M., and D. Taylor. 1979. Fire history of a sequoia-mixed conifer forest. Ecology, 60(1), 129-142.

Klug, R. R. 1997. Occurrence of Pacific fisher (*Martes pennanti*) in the Redwood Zone of northern California and the habitat attributes associated with their detections. Unpublished Master's thesis, Humboldt State University, Arcata, CA.

Knight, R. L., and K. J. Gutzwiller. 1995. Wildlife and Recreationists: Coexistence through Management and Research. Washington, D.C.: Island Press.

Krohn, W. B., S. M. Arthur, and T. F. Paragi. 1994. Mortality and vulnerability of a heavily trapped fisher population. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 137-146). Ithaca, NY: Cornell University Press.

Krohn, W. B., W. J. Zielinski, and R. B. Boone. 1997. Relationships among fishers, snow, and martens in California: results from small-scale spatial comparisons. In G. Proulx, H. N. Bryant, & P. M. Woodard (Eds.), *Martes: taxonomy, ecology, techniques, and mangement* (pp. 211-232). Edmonton, Alberta, Canada: Provincial Museum of Alberta.

Lamberson, R. H., R. L. Truex, W. J. Zielinski, and D. MacFarlane. 2000. Preliminary analysis of fisher population viability in the southern Sierra Nevada . Arcata, CA: Humboldt State University.

Lande, R. 1993. Risks of population extinction from demographic and environmental stochasticity and random catastrophes. American Naturalist, 142, 911-927.

Lande, R., and G. F. Barrowclough. 1987. Effective population size, genetic variation, and their use in population management. In M. E. Soule (Ed.), *Viable populations for conservation* (pp. 87-123). Cambridge: Cambridge University Press.

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.

Leonard, R. D. 1986. Aspects of reproduction of the fisher, *Martes pennanti*, in Manitoba. The Canadian Field-Naturalist, 100, 32-44.

Lewis, J. C., and D. W. Stinson. 1998. Washington State status report for the fisher. Olympia, WA: Washington Department of Fish and Wildlife.

Lewis, J. C., and W. J. Zielinski. 1996. Historical harvest and incidental capture of fishers in California. Northwest Science, 70(4), 291-297.

Lyon, L. J., K. B. Aubry, W. J. Zielinski, S. W. Buskirk, and L. F. Ruggiero. 1994. The Scientific Basis for Conserving Forest Carnivores: Considerations for Management. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, & W. J. Zielinski (Eds.), *The scientific basis for conserving forest carnivores--American marten, fisher, lynx, and wolverine--in the western United States* (pp. 128-137). Fort Collins, CO: USDA Forest Service Rocky Mountain Forest and Range Experiment Station.

MacLean, C. D. 1990. Changes in Area and Ownership of Timberland in Western Oregon: 1961-86 (Resource Bulletin PNW-RB-170): USDA Forest Service Pacific Northwest Research Station.

MacLean, C. D., P. M. Bassett, and G. Yeary. 1992. Timber Resource Statistics for Western Washington (Resource Bulletin PNW-RB-191): USDA Forest Sercive Pacific Northwest Research Station.

Madany, M. H. a. N. E. West. 1983. Livestock grazing - fire regime interactions within montane forests of Zion National Park, Utah. Ecology, 64, 661-667.

Martin, S. K. 1994. Feeding ecology of American martens and fishers. In S. W. Buskirk, A. S. Harestad, M. G. Raphael, & R. A. Powell (Eds.), *Martens, sables and fishers: biology and conservation* (pp. 297-315). Ithaca, NY: Cornell University Press.

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.

McBride, J. R., W. Russell, and S. Kloss. 1996. Impact of human settlement on forest composition and structure. In W. R. 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.

McKay, N., P. M. Bassett, and C. D. MacLean. 1995. Timber Resource Statistics for Eastern Washington (Resource Bulletin PNW-RB-201): USDA Forest Service Pacific Northwest Research Station.

McKay, N., M. A. Mei, and G. J. Lettman. 1994. Timber Resource Statistics for Timberland Outside National Forests in Eastern Oregon (Resource Bulletin PNW-RB-203): USDA Forest Service Pacific Northwest Research Station.

McKelvey, K. S., and K. K. Busse. 1996. Twentieth-century fire patterns on Forest Service lands. In W. R. 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. Gutierrez, 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.

McNabb, W. H., and P. E. Avers. 1994. Ecological Subregions of the United States: Section Descriptions (Publication WO-WSA-5). Washington, D.C.: USDA Forest Service.

Ministry of Forests. 2000. Fisher (*Martes pennanti*). British Columbia Ministry of Forests Forest Practices Code of BC Act. Managing identified wildlife: procedures and measures V. 1.

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.

Morrison, P. H., D. Kloepfer, D. A. Leversee, C. M. Socha, and D. L. Ferber. 1991. Ancient forests in the Pacific Northwest: analysis and maps of twelve national forests . Washington, D.C.: The Wildernes Society.

Ohmann, J. L., W. C. McComb, and Z. Abdel A. 1994. Snag abundance for primary cavity-nestingbirds on nonfederal forest lands in Oregon and Washington. Wildlife Society Bulletin, 22, 607-620.

Pacific Lumber Company 1999. Habitat Conservation Plan: The Pacific Lumber Company, Scotia Pacific Holding Company and Salmon Creek Corporation.

Parsons, D. J., and S. H. DeBenedetti. 1979. Impact of fire suppression on a mixed conifer forest. Forest Ecology and Management, 2, 21-33.

Pimm, S.L., H.L. Jones, and J. Diamond. 1988. On the risk of extinction. The American Naturalist, 132, 757-785.

Plum Creek 1996. Draft Multi-Species Habitat Conservation Plan.

Powell, R. A. 1979c. Fishers, Population models and trapping. Wildlife Society Bulletin, 7, 149-154.

Powell, R. A. 1993. The fisher: life history, ecology and behavior. (Second ed.). Minneapolis: University of Minnesota Press.

Powell, R. A., and W. J. Zielinski. 1994. Fisher. In L. F. Ruggiero, K. B. Aubry, S. W. Buskirk, L. J. Lyon, & W. J. Zielinski (Eds.), *The scientific basis for conserving forest carnivores--American marten, fisher, lynx, and wolverine--in the western United States* (pp. 38-73). Fort Collins, CO: USDA Forest Service Rocky Mountain Forest and Range Experiment Station.

Quigley, T. M., and S. J. Arbelbide. 1997. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins (General Technical Report PNW-GTR-405): USDA Forest Service Pacific Northwest Research Station.

Raine, R. M. 1987. Winter food habits and foraging behaviour of fishers (*Martes pennanti*) and martens (*Martes americana*) in southeastern Manitoba. Canadian Journal of Zoology, 65, 745-747.

Rosenberg, K. V., and M. G. Raphael. 1986. Effects of forest fragmentation on vertebrates in Douglas-fir forests. In J. Verner, M. L. Morrison, & C. J. Ralph (Eds.), *Wildlife 2000: modeling habitat relationships of terrestrial vertebrates* (pp. 263-272). Madison, WI: University of Wisconsin Press.

Rummell, R. S. 1951. Some effects livestock grazing on ponderosa pine forest and range in central Washington. Ecology, 32, 594-607.

Schaffer, 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.

Scheffer, V. B. 1938. Notes on Wolverine and Fisher in the State of Washington. Murrelet, 19, 8-10.

Seglund, A. E. 1995. The use of resting sites by the Pacific fisher. Unpublished Masters Thesis, Humboldt State University, Arcata, CA.

Simpson. 1992. Habitat Conservation Plan for the Northern Spotted Owl on the California Timberlands of Simpson Timber Company: Simpson Timber Company and Regional Environmental Consultants.

Simpson Timber Company 2000. Habitat Conservation Plan. Shelton, Washington Timberlands: Simpson Timber Company Northwest Operations.

Sorini-Wilson, K. A. 1997. Horsethief furbearer management plan : USDA Sierra National Forest.

Sprague, L. 1998. Questionnaire from the Regional Forester to Sierra Nevada National Forests, concerning furbearer networks .

Stygar, P. J. 1995. Browns Meadow furbearer management plan . Madera County, California: USDA National Forest.

Suckley, G., and J. G. Cooper. 1860. The Natural History of the Washington and Oregon Territory. New York: Bailliere Brothers.

Sudworth, G. B. 1900. Stanislaus and Lake Tahoe Forest Reserves, California 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. 2000. 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.

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.

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, Missoula, MT. USDA Forest Service Intermountain Research Station, General Technical Report INT-GTR-320,

Tribal-Forestry. 1994. Hoopa Vally Indian Reservation Forest Management Plan for the period 1994-2003 (Forest Management Plan): Hoopa Valley Indian Reservation.

Truex, R. L., W. J. Zielinski, R. T. Golightly, R. L. Barrett, and S. M. Wisely. 1998. A meta-analysis of regional variation in fisher morphology, demography, and habitat ecology in California (Draft Report). Arcata, CA: USDA Forest Service Pacific Southwest Forest and Range Experiment Station.

USDA. 1988a. Lake Tahoe Basin Mangement Unit Land and Resource Management Plan. .

USDA. 1988b. Sequoia National Forest Land and Resource Management Plan. .

USDA. 1990. Tahoe National Forest Land and Resource Management Plan. .

USDA. 1991a. Modoc National Forest Land and Resource Mangement Plan. .

USDA. 1991b. Stanislaus National Forest Land and Resource Management Plan. .

USDA. 1992. Sierra National Forest Land and Resource Management Plan. .

USDA. 1993a. Decision notice and finding of no significant impact for California spotted owl Sierran Province Interim Guidelines. USDA Forest Service Pacific Southwest Region.

USDA. 1993b. Lassen National Forest Land and Resource Management Plan .

USDA. 2000. Sierra Nevada Forest Plan Amendment Draft Environmental Impact Statement : USDA Forest Service Pacific Southwest Region.

USDI. 1990. Determination of Threatened Status for the Northern Spotted Owl (Federal Register/ Vol. 55, No. 123/ Tuesday, June 26, 1990): USDI Fish and Wildlife Service.

USDI. 2000. Final Environmental Impact Statement for the Proposed Issuing of a Multiple Species Incidental Take Permit on Simpson Washington Timberlands (Final Environmental Impact Statement): USDI Fish and Wildlife Service and National Marine Fisheries Service.

USDI, and USDA. 1994. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (Final Supplemental Environmental Impact Statement): USDA Forest Service and USDI Bureau of Land Management.

van Wagtendonk, J. W. 1996. Use of a deterministic fire growth model to test fuel treatments. In W. R. 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.

Vankat, J. L. 1977. Fire and Man in Sequoia National Park. Annals of the Association of American Geographers, 67, 17-27.

Verner, J., K. S. McKelvey, B. R. Noon, R. J. Gutierrez, G. I. G. Jr., and T. W. Beck. 1992. 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. Gutierrez, 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.

Waddell, K. L., and P. M. Bassett. 1996. Timber Resource Statistics for the North Coast Resource Area of California, 1994 (Resource Bulletin PNW-RB-214): USDA Forest Service Pacific Northwest Research Station.

Waddell, K. L., and P. M. Bassett. 1997. Timber Resource Statistics for the North Interior Resource Area of California (Resource Bulletin PNW-RB-222): USDA Forest Service Pacific Northwest Research Station.

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. Gutierrez, 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.

Wisdom, M. J., R. S. Holthausen, B. C. Wales, C. D. Hargis, V. A. Saab, D. C. Lee, W. J. Hann, T. D. Rich, M. M. Rowland, W. J. Murphy, et al. 2000. Sources Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin: Broad-Scale Trends and Management Implications (General Technical Report PNW-GTR-485): USDA ForestService Pacific Northwest Research Station.

Witmer, G. W., S. K. Martin, and R. D. Sayler. 1998. Forest Carnivore Conservation and Management in the Interior Columbia Basin: Issues and Environmental Correlates (General Technical Report PNW-GTR-420): USDA Forest Service Pacific Northwest Research Station.

York, E. 1996. Fisher population dynamics in north-central Massachusetts. Unpublished MS thesis, University of Massachusetts, Amherst, MA.

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. Gutierrez, 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.

Zielinski, W. J. 1999. Microhabitat selection by fishers. Presentation at the Wildlife Society meeting, Austin, Texas.

Zielinski, W. J., R. H. Barrett, and R. L. Truex. 1997b. Southern Sierra Nevada fisher and marten study: progress report IV . Arcata, CA: USDA Forest Service Pacific Southwest Research Station.

Zielinski, W. J., T. E. Kucera, and R. H. Barret. 1995a. Current Distribution of the fisher, *Martes pennanti*, in California. California Fish and Game, 81(3), 104-112.

Zielinski, W. J., G. A. Schmidt, and K. N. Schmidt. 1995b. Six Rivers National Forest Fisher Study Progress Report II . Arcata, CA: USDA Forest Service Pacific Southwest Research Station.

Zielinski, W. J., and H. B. Stauffer. 1996. Monitoring *Martes* populations in California: survey design and power analysis. Ecological Applications, 6, 1254-1267.

Zielinski, W. J., R. L. Truex, C. V. Ogan, and K. Busse. 1997a. Detection surveys for fishers and American martens in California, 1989-1994: summary and interpretations. In G. Proulx, H. N. Bryant, & P. M. Woodard (Eds.), *Martes: taxonomy, ecology, and management* (pp. 372-392). Edmonton, Alberta, Canada: Provincial Museum of Alberta.

Zielinski, W. J., N.P. Duncan, E.C. Farmer, R. L. Truex, A.P. Clevenger, and R.H. Barrett. 1999. Diet of fisher (*Martes pennanti*) at the southernmost extent of their range. Journal of Mammalogy, 80(3), 961-971.

Zielinski, W. J., R. L. Truex, L.A. Campbell, C.R. Carroll, and Frederick V. Schlexer. 2000. Systematic surveys as a basis for the conservation of carnivores in California forests, progress report II: 1996-1999. USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, Arcata, CA.