



Review of Habitat Claims in the Petition to List the Pacific Fisher as an Endangered or Threatened Species under the California Endangered Species Act

**by Stephen F. Mader, Ph.D.
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Review of Habitat Claims in the Petition to List the Pacific Fisher as an Endangered or Threatened Species under the California Endangered Species Act

By Stephen F. Mader, Ph.D., CSE, CF, PWS¹

This white paper examines the Pacific fisher habitat claims of the petition to list the Pacific fisher (*Martes pennanti*) as an endangered or threatened species under the California Endangered Species Act (CBD 2008). The white paper finds that the listing petition's claims about the carnivore's habitat requirements for denning, resting, and foraging at the plot, stand, and landscape scales warrant clarification and expansion. Further examination and interpretation of the scientific literature describing fisher habitat requirements, preferences, and associations indicate that the petition's discussion of fisher habitat mischaracterizes or omits key studies from the literature, and draws conclusions that are imprecise and misleading.

The following discussions provide individual statements from the listing petition, page references, and discussions of the claims. This examination of fisher habitat claims focuses on three investigative areas:

- Do statements made in the listing petition accurately reflect the literature study cited?
- Is there scientific literature relevant to a particular habitat claim that the listing petition failed to cite?
- Are the conclusions drawn from the petition about fisher habitat requirements reasonable?

¹ Senior Technologist for Habitat Management and Planning, CH2M HILL, Inc., Portland, Oregon. The opinions expressed in this white paper are those of the author.

**"Studies on the habitat use of fishers in the western United States demonstrate that the fisher is strongly associated with mature and late successional forests."
(CBD 2008; page 7)**

Does this statement in the listing petition accurately reflect the literature cited?

Aubry and Houston (1992): No; authors acknowledge that their historical records survey, based primarily on unverified sightings, is "no substitute for the intensive field work that will be required to quantitatively determine the habitat requirements and population status of *M. pennanti*." Their survey data associate fisher distribution with forest zones and elevations; however, no data on forest age, structure, cover, size, management history, etc. are provided.

Buck et al. (1994): No; these authors actually found fishers in "lightly harvested" and "heavily harvested" forests. Although they found adult female fishers to be more selective in the heavily harvested forest, more individual fishers were observed in the heavily harvested forests. Despite their claim that forest management practices that reduce mature conifers result in suboptimal fisher habitat, they observed 14 individual fishers in the 28-mi² area described as "heavily harvested," but observed only 8 individual fishers in the slightly larger 30-mi² area described as "lightly harvested." They reported that fishers use recent clearcuts with dense brush. Also, Buck found 5 of 8 fisher rest sites in timber harvest units in which >20% of the canopy was removed.

Campbell (2004): No; in statistical analysis, fisher was significantly associated with drier areas, hardwoods, dense stands of medium-sized trees, shrub cover, and steep slopes. The best model for classifying fisher presence was at the plot scale and consisted of a single variable, slope. The slope variable appears to account for the influence of other habitat components, and when statistically controlled across sites, shows fisher responding to greater shrub cover, greater hardwood basal area, and greater canopy closure, but not necessarily "mature and late successional forests."

Carroll et al. (1999): No; univariate analysis identified fishers are significantly ($p < 0.1$) associated with tree canopy closure, hardwood diameter, and conifer variance. Final best fit association model included tree canopy closure moving average (positive effect), tree size class moving average (negative but complex effect), and percent conifer MA (stronger correlation with hardwood or mixed forests). Over a regional scale, the authors found significant relationships with tree canopy closure, percent conifer (interaction effect—tree canopy closure has a more positive effect in mixed conifer/hardwood than a purely conifer landscape), and tree size (generally negative). The latter finding conflicts with fine-scale studies, but is perhaps attributable to characteristics of mixed forests that have higher canopy closure in younger stands; however, tree size has a complex effect and interpretability is limited.

Dark (1997): No; comparisons showed significant fisher responses ($p = 0.05$ or less) to: (1) more Douglas-fir (mi²), (2) more 51-75% canopy cover (mi²), and (3) more low-use road density (mi). The preference for stands with 51-75% canopy cover does not appear consistent with mature and late-successional forests.

Jones and Garton (1994): No; they reported that fishers used mature forests more in summer, whereas young forests were used more in winter (non-forest or pole-sapling areas were avoided). Also, fishers used a broader range of successional stages for hunting than for resting, and fishers used recent clearcuts for hunting once a dense cover of shrubby vegetation was established. They suggested that fishers make forays into non-forested habitats for prey.

Mazzoni (2002): No; this researcher found that female home ranges had significantly higher proportions of habitat classified as CWHR class 1 (i.e., tree cover 60-100% by trees >11 inches dbh) and lower proportion of CWHR class 4 (tree cover 10-24% by trees >11 inches dbh) than random areas, but 11-inch trees would not be considered mature or late-successional forests. Analysis of

habitat class based on cover of >24-inch trees was attempted, but not used due to a large amount of "no data" area.

Powell and Zielinski (1994): Although these authors report that fishers may prefer late-successional forests in portions of their range, they occupy extensive mid-mature, second-growth forests in other parts of their range. Furthermore, they stated, "existing data are inadequate to assess the use of forest areas with intermediate forest cover resulting from either natural or human-caused disturbances."

Seglund (1995): No; this author limited her study of fisher habitat to rest site characterization at the plot scale (<0.1 ac). She did not attempt to describe fisher habitat for foraging or other uses, nor did she attempt to characterize habitat associations throughout the home range.

Truex et al. (1998): The scope of this study is limited to rest sites and characteristics surrounding rest sites, and only general composition of study areas. Authors stated, "Methodological differences limited our ability to make comparisons of habitat and physical environment surrounding rest sites across study areas," and their estimates of canopy closure, basal area, and tree diameter were based on plot data, not stand or landscape data. The authors found that fishers rested in smaller diameter trees in the eastern Klamath area with history of timber harvest, and more timber harvest by clearcutting.

Zielinski et al. (2004a): No; the findings of this study are limited to fisher resting habitat features and forest conditions immediately surrounding them. They found that rest sites had larger maximum dbh, average canopy closure, shrub canopy cover, more large snags, and steeper slopes than random sites. However, they did not verify the importance of rest site conditions as the limiting fisher resource.

Zielinski et al. (2004b): No; these authors do not provide comparative data that would allow interpretation of optimal proportions of forest types, cover categories, or seral stage in fisher home ranges. Their study areas contained clearcuts and regenerating forest, second and third growth; and relatively unfragmented forest with individual-tree selection harvest.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Self and Kerns 2001: These authors found that the USDI Fish and Wildlife Service HSI model for fisher underpredicted significant use of high-brush-cover open-forest conditions (25-40% tree canopy cover) by fisher in summer. Forest openings without overhead cover were suitable if significant brush or hardwood ground cover is present. Although fisher selected for mature and old-growth forest, they found equally strong selection for other stand types. Over 48% of rest sites were seedling/sapling or pole-sized forest structures.

Is the interpretation of fisher habitat requirements reasonable?

No. This statement that fisher habitat is "strongly associated with mature and late successional forests" is an overextension of known species-habitat interactions. Generally, the citations either fail to report first-hand evidence of such interactions, or the data obtained about habitat attributes associated with Pacific fisher are extrapolated beyond the appropriate landscape scale at which the data were obtained.

The fisher literature is replete with reports of fisher presence and habitat use at landscape conditions other than "mature and late successional forests," and fisher is not found in such forests in much of its range (e.g., Powell and Zielinski 1994). Numerous investigators surmise that "stand age may not be as important in determining stand use by fishers as the structural characteristics that provide foraging, resting, and denning sites for fishers, and affect snow depth and density" and that fisher decisions on habitat selection are driven by potential for prey capture success (e.g., Lewis and Stinson 1998; Powell 1994).

"Based on an extensive review of existing studies, Buskirk and Powell concluded: "Do American martens and fishers require particular forest types—for example, old-growth conifers—for survival? We think they do." (CBD 2008; page 7)

Does this statement in the listing petition accurately reflect the literature cited?

Buskirk and Powell (1994): The quotation from Buskirk and Powell is taken out of context to imply that fishers require old-growth conifers. In fact, Buskirk and Powell contend that fishers focus on "particular forest types"; that is, specific habitat features for their various life history needs, and fishers prefer habitats with cover and physical complexity near the ground to support their prey base. For example, the authors state that choices of *Martes* resting places are made "on the scale of the individual piece of coarse woody debris and were relatively nonselective at larger scales" (Wilbert 1992). They provide numerous references to fisher literature documenting the wide range of habitat conditions where fishers are found, including habitats in managed landscapes. They say that "patches of preferred habitat that are interconnected by other forest types" are used by fishers.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Some researchers have deemed fisher to be "adaptable to different habitats" (Strickland et al. 1982). Others found fishers with "no significant [habitat] preference," or preferring "forests tending toward low and closed (although not uniform) canopies," and fishers were "active more than expected in recent clear-cuts" (Kelly 1977). Self and Kerns (2001) found 48% of fisher rest sites in seedling/sapling or pole-sized forests, although the trees in the immediate vicinity of the rest sites were above average for the stand. Similarly, Thomasma et al. (1991) found that fisher used open-forest stand conditions more than expected, though a significant ground cover of brush may be required.

Is the interpretation of fisher habitat requirements reasonable?

No. Buskirk and Powell actually suggest that habitats used by fishers "are forest or woodland landscape mosaics that include conifer dominated stands" with "variable amounts of broad-leaved (hardwood)." They say that "some animals never used open or nonforested areas...whereas others would occasionally travel along edges of open areas and cross narrow open areas," and that "findings fail to support a unifying principle of edge use." The authors report that "fishers recolonized midsuccessional second-growth forested areas" and generalize that fisher habitat choices are linked to their prey (e.g., snowshoe hare), such as "physical complexity near the forest floor." The main point made by Buskirk and Powell is that fishers require particular forest types—and habitat attributes—for survival. They do not imply that fishers require old-growth forest for survival.

“Resting sites are typically located within stands dominated by late-successional forest characteristics, such as large trees and snags, coarse woody-debris, high canopy closure, and multiple canopy layers.”

(CBD 2008; page 9)

Does this statement in the listing petition accurately reflect the literature cited?

Truex et al. 1998: No, these authors make no claims about the forest stand conditions surrounding fisher rest structures; only that plots containing rest structures contain average canopy closure ranging from 88.2% to 93.9%; average diameters of the four largest trees ranging from 18.2 to 46.6 in; and plot basal area ranging from 260.5 ft²/ac to 329.3 ft²/ac. However, plots had canopy closure as low as 3%, average tree diameter as low as 2.7 in, and basal area as low as 40.1 ft²/ac. The authors hypothesize, “the availability of a diversity of structural elements across the landscape may play a crucial role in successful reproduction and recruitment of young.”

Zielinski et al. (2004a): No; although these researchers found rest sites with larger maximum dbh, average canopy closure, shrub canopy cover, more large snags, their data do not address stand-, landscape-, or home-range-scale forest preferences of fisher.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Weir and Harestad (2003): These researchers found fishers in disturbed landscapes with history of large fires, timber harvest, land clearing for agriculture, and grazing. Within the landscapes, fishers selected habitats based on overhead cover, foraging, and snow interception at the stand and patch scale; and sought resting and denning habitat at stand, patch, and elemental scales. Fishers selected atypical habitat patches in forest stands lacking preferred structural attributes, selected atypical habitat elements (e.g., rust brooms, black cottonwood cavities) in habitat patches, and avoided habitats or stands without overstory or shrub cover. They used patches with greater cover within stands with low overhead cover.

Rosenberg and Raphael (1986): These investigators recommended that forest stands should not be tallied as old-growth, regardless of their age or stocking characteristics, unless they are >123 ac because smaller stands tend to lack the full complement of vertebrate species and should be excluded as viable stands.

Is the interpretation of fisher habitat requirements reasonable?

No. The statement is imprecise and misleading. It incorrectly implies that fisher rest sites occur in stands dominated by late-successional forest characteristics. In fact, scientific studies have found that fishers select rest sites based on rest site characteristics, not the characteristics of the surrounding stand. Very few researchers have attempted to characterize resting habitat beyond the plot scale, and those who have tried did not find that rest site location depends on late-successional forests.

Truex et al. (1998) reported “extensive use of small diameter trees was observed on the Eastern Klamath study area” and “relatively limited use of large diameter live trees and snags” there. The authors did not determine the age or structure of forest stands surrounding the rest sites.

"The Pacific fisher is probably associated with late-successional forest conditions because these stands contain the large trees, snags, and logs used by fishers as rest or den sites."

(CBD 2008; page 9)

Does this statement in the listing petition accurately reflect the literature cited?

Powell and Zielinski (1994): This statement is consistent with some sentiments expressed by these authors; however, the association is less strong for many portions of the range and for activities other than denning and resting. They stated that, "existing data are inadequate to assess the use of forest areas with intermediate forest cover resulting from either natural or human-caused disturbances."

Truex et al. (1998): No; these authors make no claims about the forest stand conditions surrounding fisher rest structures, and did not describe fisher den sites. Instead, they describe forest conditions at rest sites, and that the habitat conditions vary across California. Also, they reported "extensive use of small diameter trees was observed on the Eastern Klamath study area" and "relatively limited use of large diameter live trees and snags [there]"; which conflicts with the listing petition.

Zielinski et al. (2004a): No; these researchers described habitat features at fisher rest sites. They did not characterize the forest age or conditions away from the rest sites, and they did not demonstrate rest site conditions as the limiting fisher resource.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Jones and Garton (1994): Old-growth stands were used in proportion to their availability for both hunting and resting, although mature stands were preferred. Fishers preferred young forest in winter, selecting it disproportionately over its availability.

Is the interpretation of fisher habitat requirements reasonable?

No. The interpretation is imprecise and misleading. It incorrectly implies that fishers are dependent on late-successional forests. In fact, the referenced studies did not determine that fishers select for late-successional forests. The researchers did not determine the age or structure of forest stands surrounding denning or rest sites. Instead, the studies focused their investigations on structures for denning and resting. Rather than conclude that fisher is associated with late-successional forest conditions, Truex et al. 1998 hypothesized, "The availability of a diversity of structural elements across the landscape may play a crucial role in successful reproduction and recruitment of young." Although forest structures at observed fisher rest sites might be found in late-successional forest, it is important to note that these researchers do not conclude that fisher require late-successional forests.

“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.”
(CBD 2008; page 10)

Does this statement in the listing petition accurately reflect the literature cited?

Powell and Zielinski (1994): The statement is consistent with some sentiments expressed by the authors; however, the authors also stated that, “existing data are inadequate to assess the use of forest areas with intermediate forest cover resulting from either natural or human-caused disturbances.” Furthermore, they reported that more recent investigations in northern California indicated that fishers are detected in second-growth forests and in areas with sparse overhead canopy, but use of these areas is not fully understood.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Lewis and Stinson (1998) summarized the relationship between fisher habitat and late-successional forests by stating, “stand age may not be as important in determining stand use by fishers as the structural characteristics that provide foraging, resting, and denning sites for fishers, and affect snow depth and density.” Also, they cautioned that “the importance of late-successional forest to fishers in the west has been the subject of much discussion and needs further study.”

Is the interpretation of fisher habitat requirements reasonable?

No. The interpretation is imprecise and misleading. It incorrectly implies that the large physical structures used as rest sites by fisher typically occur in late-successional forests. It is widely recognized that fishers use large physical structures for rest sites. However, it is not widely believed that fishers require the maintenance of late-successional forests for resting or throughout large portions of their range. In fact, numerous studies have concluded that fishers select rest sites independently of forest structure or age. More recent studies have found that fishers use home ranges with sufficient rest structures distributed throughout continuous forest with good cover and prey support. Such conditions can be found in actively-managed landscapes.

**“Presumed foraging habitat, similar to resting and denning habitat, is often typified by characteristics associated with mature and late-successional forests.”
(CBD 2008; page 10)**

Does this statement in the listing petition accurately reflect the literature cited?

Dark (1997): No; comparisons showed significant ($p = 0.05$ or less) positive fisher responses to: (1) more Douglas-fir (mi^2), (2) more 51-75% canopy cover (mi^2), and (3) higher-density low-use roads (mi). The preference for stands with 51-75% canopy cover does not appear consistent with mature and late-successional forests. Although fisher are associated with riparian habitat, any possible correlation with high crown cover and dense understory in riparian areas may be confounded by fisher's general preference for riparian areas, as demonstrated in other studies. In fact, Dark did not find that fishers “use late-successional habitats for all activities, including resting, traveling, and foraging.” She found no significant difference in landscape habitat characteristics between fisher rest sites and foraging areas.

Jones and Garton (1994): No; these authors found that within young stands used in winter, fishers selected sites with higher availability of large trees (>18.5 in dbh), snags (>20.5 in dbh), and logs (>18.5 in). The young stands in the study area were naturally regenerated after a stand replacement fire, and contained some of the structure associated with older forest. They suggest that management at a landscape scale should incorporate a variety of young- to mid-successional stages to support a variety of prey species, in conjunction with retention of sufficient denning and resting structures. They suggested that forest management practices that “mimic natural landscape patterns and processes may not be detrimental to fisher populations.”

Zielinski (1999): The claim that fisher foraging habitat is associated with mature and late-successional forests cannot be substantiated because there is no evidence that the referenced presentation was published, although an abstract of the oral presentation may be available.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Lewis and Stinson (1998) summarized fisher habitat as having: “high percentage of canopy closure, abundant large woody debris, large snags and cavity trees, and understory vegetation...high degree of diversity; multi-aged stands interspersed with small openings and containing wetland or riparian habitats which help support a diverse prey base...forest near swamps, especially swamps in large timber.” They concluded that “stand age may not be as important in determining stand use by fishers as the structural characteristics that provide foraging, resting, and denning sites for fishers, and affect snow depth and density.”

Buskirk and Powell (1994) summarized fisher habitat as forest or woodland landscape mosaics tending toward: “low and closed (although not uniform) canopies...that include conifer dominated stands [with] variable amounts of broad-leaved (hardwood).”

These literature summaries suggest that fisher foraging habitat can include a wide range of landscape conditions where preferred habitat elements are found. The preferred habitat elements are not found exclusively in mature and late-successional forests.

Is the interpretation of fisher habitat requirements reasonable?

No. The petitioners presume that fisher foraging habitat contains “characteristics associated with mature and late-successional forests.” In fact, the literature suggests that fishers focus on specific habitat structures and elements where prey can be obtained with relative ease, regardless of forest successional stage. Fisher habitat requirements are met by ranges of forest successional conditions across the landscape.

“Zielinski documented that fishers on the North Coast of California foraged 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 percent for sites with detections compared to 79.0 percent for sites without detections) than stands where fishers were not found, and that fishers in the southern Sierra foraged in stands with higher canopy closure of trees and shrubs than stands where fishers were not found.”
(CBD 2008; page 10)

Does this statement in the listing petition accurately reflect the literature cited?

Zielinski (1999): This habitat claim, which was first made in the Center for Biological Diversity's 2000 petition to list the fisher, cannot be substantiated because there is no evidence that the presentation was published, although an abstract of the oral presentation may be available.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Campbell (2004): This author reported that “microhabitats where fishers were present at baited stations in the Sierra Nevada tended to have larger conifer and hardwood trees, steeper slopes, more shrub cover, and fewer roads than areas where no fishers were detected. At the landscape level, sample units within the fisher detection area were negatively associated with precipitation, road density, and discontinuity of habitat.”

In contrast to Campbell (2004), Weir and Harestad (2003) found that fishers avoided stands with >80 percent closure of the low shrub layer. They hypothesized that very high shrub cover may negatively affect hunting success.

The body of scientific literature suggests that fishers tend to forage in forests with relatively high tree or shrub cover and understory habitat complexity that favors prey (e.g., Buskirk and Powell 1994). The literature is silent on the claim that fishers are dependent on mature and late-successional forests.

Is the interpretation of fisher habitat requirements reasonable?

No. The habitat claims cannot be verified. It is reasonable to assume that fishers prefer forests with high tree or shrub cover and where prey are found; however, fishers utilize all ages of forest, including managed timberland, if adequate cover and prey are present, and sufficient denning and resting sites are available in the home range.

“Klug 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 percent) and that track plate surveys are unable to detect whether or not fishers are using the area incidentally or regularly.”
(CBD 2008; page 10)

Does this statement in the listing petition accurately reflect the literature cited?

Klug (1997): Klug found no significant fisher detections among managed timberland ranging in age from recently cut to 120 years old. Overall, fishers were detected at 30% of stations, and 65% of 3.1-mi segments. Major factors contributing to high detection rates were elevation, volume of logs, slope angle, basal area of conifers, and distance from coast. Although nearly all stands were managed young-, second-, or third-growth forests, many contained significant residual timber components. Track plate surveys provide quantitative data for determining fisher presence and distribution.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Self and Kerns (2001): These researchers found that fisher selectively used higher cover classes, but where cover was higher, fishers used a variety of tree age classes. They selected for dense, older forests, but showed equal selection for other forest types. Fisher selected open-forest stands (25-40% cover) with the caveat that rest sites were in small areas (0.1-5 ac) of denser cover. Open stands in the study area had a heavy layer of brush, which could provide overhead cover for fisher.

Is the interpretation of fisher habitat requirements reasonable?

No. The important conclusion to be drawn from this study is that fishers were highly associated with managed timberland, which apparently contained habitat features preferred by fishers, including adequate cover, prey support, perviousness (insularity), and possibly denning and resting sites. Apparently, fishers do not require late-successional or old-growth forests (<2 percent of study area) if their habitat needs are satisfied. The cautionary statement about track plate surveys applies to many fisher studies, not just Klug's; however, the high detection rates of this study suggest that fishers used the study area regularly.

“A number of studies have shown that fishers avoid areas with little forest cover or significant human disturbance and prefer large areas of contiguous interior forest.” (CBD 2008; page 10)

Does this statement in the listing petition accurately reflect the literature cited?

Dark (1997): No; Dark found non-significant positive correlation in individual t-tests between fisher detections and fewer “barren” patches, but the correlation was significant in the logistic regression model. (“Barren” areas were those with little vegetative growth, roads, and meadows.) In any case, the response appears limited because “barren” areas were present in relatively small amount (~5-15% of 1.2 mi² buffer). Also, she found significant positive correlation between fisher presence and high road density, although roads were low-use.

Jones and Garton (1994): No; these researchers detected fishers in various forest configurations, with varying management history. They found that fishers “preferred” young forest in winter, selecting it disproportionately over the amount available, and found that old-growth stands were used in proportion to their availability for both hunting and resting. They reported that fishers used a broader range of successional stages for hunting than for resting, and that hunting observations included the pole-sapling forest cover type. Furthermore, they suggested that fishers make forays into non-forested habitats for prey.

Powell (1993): No; Powell reported that fishers in eastern and mid-western U.S. forests are associated with mid-successional and mature second-growth stands of lowland conifers and upland hardwoods, although with high canopy closure. He stated that fishers have responded positively to successional forest conditions, and that reintroductions of animals into favorable second-growth habitat have been successful. Although fishers are observed as late-successional associates in the West, this difference may reflect a response to forest structure rather than seral stage.

Rosenberg and Raphael (1986): Fisher response at broad-scale variables showed higher correlation with stand insularity ($p < 0.001$) than with any other habitat measure, but actually decreased in frequency in stands > 247 ac. Fisher had declining detection frequency in plots with closer proximity to and greater length of a clearcut edge; however the authors state that most clearcuts were of recent origin, thus organisms/populations may not have fully adjusted responses to changing landscape.

Carroll et al. (1999): No; these authors found that although tree canopy closure is a significant factor in fisher presence, and that tree canopy closure has a more positive effect in mixed conifer/hardwood than a purely conifer landscape, they found that tree size generally is negatively related. The latter finding may be attributable to characteristics of mixed forests that have higher canopy closure in younger stands. Road density was not significantly related to fisher presence.

Seglund (1995): No; this investigator limited her study to characterization of fisher rest sites. She did not describe avoidance areas, effects of human disturbance, or preferred forest conditions beyond the area immediately surrounding the rest sites.

Weir and Harestad (2003): No; these researchers found fishers in disturbed landscapes with history of large fires, timber harvest, land clearing for agriculture, and grazing. Within the landscapes, fishers selected habitats based on overhead cover, foraging, and snow interception at the stand and patch scale; and sought resting and denning habitat at stand, patch, and elemental scales. Fishers selected atypical habitat patches in forest stands lacking preferred structural attributes, selected atypical habitat elements (e.g., rust brooms, black

cottonwood cavities) in habitat patches, and avoided habitats or stands without overstory or shrub cover. They used patches with greater cover within stands with low overhead cover.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Buskirk and Powell (1994) reported that fishers “occasionally travel along edges of open areas and cross narrow open areas” and their findings “fail to support a unifying principle of edge use.”

Kelly (1977) reported that fishers are “active more than expected in recent clear-cuts.”

The literature review by Lewis and Stinson (1998) summarized fisher habitat as “forests with a high percentage of canopy closure, abundant large woody debris, large snags and cavity trees, and understory vegetation” with “a high degree of diversity; multi-aged stands interspersed with small openings and containing wetland or riparian habitats which help support a diverse prey base.” Furthermore, they present numerous instances of managed forest habitat use by fisher. They made no mention of interior forest conditions.

Many researchers found that fisher use forests “interspersed with small openings,” “forest or woodland landscape mosaics,” and forests with “low and closed (although not uniform) canopies” (Lewis and Stinson 1998; Buskirk and Powell 1994). The key seems to be sufficient quantity of habitat with effective cover for supporting prey base and facilitating foraging.

Is the interpretation of fisher habitat requirements reasonable?

No. The statement is reasonable in that fishers mostly avoid areas with little forest cover; however, young forest or high shrub cover appear adequate for foraging habitat if a prey base and rest sites are available. The statement is reasonable in that fishers prefer large areas of contiguous forest. However, it is misleading to state that fishers prefer interior forest. There is plenty of evidence that fishers use forest openings, managed timberland, and second-growth forest. Roaded areas are used if the roads do not prevent fisher movement across them (Powell 1994; Dark 1997).

"Several studies have shown that fishers are associated with riparian areas. For example, Aubry and Houston 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. Zielinski et al. found that proximity to water was an important variable in the resting site selection by southern Sierran fishers, possibly because fishers prefer mesic sites in this relatively dry habitat." (CBD 2008; page 11)

Does this statement in the listing petition accurately reflect the literature cited?

Aubry and Houston (1992): No; the authors actually reported that fisher historically were found in "swamps or other forested riparian areas" presumably because such habitats "generally have dense canopies and abundant prey." They provide no data for wet or riparian forest habitat conditions (i.e., age, structure, cover, landscape context, management history, etc.) where fishers were observed.

Dark (1997): This investigator found that fishers were positively correlated with riparian areas containing Douglas-fir with high crown cover and a dense understory of dogwood and vine maple trees. However, Dark was unable to determine why fishers used the riparian areas, which may have been confounded landscape-level factors other than riparian tree and understory cover.

Seglund (1995): No; this investigator encountered riparian areas with "a wide diversity of riparian conditions...undisturbed sites, recovering sites, and sites in need of restoration." She suggested several reasons why fishers seem to prefer riparian areas: "the physiography of small order tributary streams of a drainage network," they "maintain lower and more stable temperatures than upland areas," they may furnish "thermal cover and snow interception in the winter," and they provide higher "density and diversity of prey." She concluded, "the specifics of why fishers rested near riparian and streamside habitats was unresolved in this study."

Zielinski (1999): The claim that fisher prefer riparian forests because they are in some cases protected from logging cannot be substantiated because there is no evidence that the referenced presentation was published, although an abstract of the oral presentation may be available.

Zielinski et al. (2004a): Yes; these researchers found almost twice as many resting sites as random points within 328 ft of water in the Sierra study area where surface water was less common.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Lewis and Stinson (1998) summarized the fisher literature by stating good fisher habitat seems to contain "wetland or riparian habitats which help support a diverse prey base," that fishers "seem to prefer forest near swamps, especially swamps in large timber," and that "riparian habitats are used extensively by fishers, especially as travel corridors and rest sites"; however, they provide no data for forest age, structure, cover, landscape context, or management history at wet or riparian forests where fishers were observed.

Self and Kerns (2001): Although they found nearly 60% of fisher use to occur within 500 ft of water, these researchers found that fisher use is not restricted to areas near water. They found significant selection for habitat types at least 2,500 ft from water.

Is the interpretation of fisher habitat requirements reasonable?

It is reasonable to assume that fisher is associated with forested wetlands and riparian areas, which may possess dense canopies, abundant prey, and other specific habitat attributes that fishers find attractive. It is unreasonable to infer that fisher association with these areas results from protection from logging or displacement from managed forests. Furthermore, it is unreasonable to presume that disturbance-prone riparian forests have dense canopy closure, large trees, and general structural complexity. Forested wetlands and riparian areas historically have been subjected to natural disturbances and timber harvest, although current forest practices in riparian areas are more restrictive. A reasonable conclusion from the literature would indicate that fishers require a water source, adequate prey base, adequate cover, and suitable resting sites.

"Indeed, elimination of late-successional forest characteristics from large portions of the Sierra Nevada and Pacific Northwest has probably contributed to the significant diminution of the fisher's historic range on the West Coast."

(CBD 2008; page 11)

Does this statement in the listing petition accurately reflect the literature cited?

Aubry and Houston (1992): No: (1) the authors provide no data for fisher habitat relationships or range in California; (2) the authors provide no data describing forest age, structure, cover, size, management history, etc. where fisher were found; and (3) their records actually "provide evidence for the continued presence of *M. pennanti* in broad areas that were occupied in the recent past." They conclude that they "cannot determine the status of extant populations."

McKelvey and Johnson (1992): No; these authors do not provide any interpretation of fisher habitat requirements at any scale, and the scope of study was not coincident with fisher's range in California.

Morrison et al. (1991): No; these authors address neither the historical range of Pacific fisher, nor the fisher's habitat preferences or requirements. Although they provide a 19-year-old, GIS-based estimate of the distribution of older forest among 12 national forests in California, Oregon, and Washington, they provide no data upon which to judge the status of Pacific fisher.

Franklin and Fites-Kaufmann (1996): No; these authors do not provide any interpretation of fisher habitat requirements at any scale, and the scope of study was not coincident with fisher's range in California.

Lewis and Stinson (1998): No; these authors state that "the importance of late-successional forest to fishers in the west has been the subject of much discussion and needs further study." These authors further reported that although fishers are associated with late-successional conifer forests, they also use younger stands, especially as foraging habitat.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Holthausen et al. (1994) stated that fishers are not dependent on late-successional forest, but require closed- canopy forest with adequate prey populations.

Arthur et al. (1989) and Powell (1993) reported that fishers are associated with mid-successional and mature second-growth stands of lowland conifers and upland hardwoods with high canopy closure.

Roy (1991) did not detect any selection for stand age (seedling through large saw-timber) by fishers introduced into Montana.

Jones and Garton (1994) reported that fishers showed a selection for young forests in winter, and they speculated that the winter selection for young stands may have been in response to greater availability or vulnerability of prey in these cover types in winter.

Is the interpretation of fisher habitat requirements reasonable?

No. This statement that elimination of "late-successional forest characteristics...probably contributed to the significant diminution fisher range" is an overextension of known fisher distribution and species-habitat interactions. Generally, the citations either fail to report first-hand evidence of habitat interactions or range distribution, or the data are extrapolated beyond the appropriate landscape scale at which the data were obtained.

“Home-range size likely varies with quality of habitat. Truex et al. 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.”
(CBD 2008; page 11)

Does this statement in the listing petition accurately reflect the literature cited?

Truex et al. (1998): No; these investigators speculated that fisher home range is smaller where quality of habitat is greater; however, there exists much uncertainty about which combinations of parameters constitute quality fisher habitat. Although they found home range in the Eastern Klamath the largest among three study areas, they were unable to demonstrate causal effects or to substantiate that the forest conditions of the Eastern Klamath were low quality.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Buck et al. (1983): These authors actually found the opposite effect, such that the habitat hypothesized to be best for fisher consistently had larger average home ranges than the habitat judged to be “less suitable” for fisher. Despite their claim that forest management practices that reduce mature conifers and increase the proportion of hardwoods result in suboptimal fisher habitat, they observed 14 individual fishers in the 28 mi² area described as “heavily harvested,” but observed only 8 individual fishers in the slightly larger 30 mi² area described as “lightly harvested.”

Kelly (1977): Identification of quality habitat is confounded because fishers prefer “forests tending toward low and closed (although not uniform) canopies” and were “active more than expected in recent clear-cuts.”

Lewis and Stinson (1998): Home range sizes of fishers vary widely for individuals and by region. Typically, male home ranges (average 15.4-19.3 mi²) are two to three times the size of female home ranges (5.8-7.7 mi²). Sex-specific differences in home range size may be a result of differential resource use (i.e., males seek access to females, while females seek access to food). The home ranges of males often overlap more than one female home range.

Mazzoni (2002): This investigator did not address the relationship of fisher home range size to habitat quality, but she noted that female home ranges contained a higher proportion of forest with >60% cover by trees >11 inches dbh. Habitat quality was assumed, not determined.

Powell and Zielinski (1994): They state that there is no clear pattern in home range sizes, although the largest have been recorded in western states and provinces; and that home range data often include extra-territorial excursions by males.

Zielinski et al. (2004b): These investigators found that fisher home ranges were larger in the Coastal study area than the Sierra study area. They conjectured that high quality black oak habitat in the Sierras accounts for the smaller home range size. They do not provide comparative data that would allow interpretation of optimal proportions of forest types, cover categories, or seral stages in home ranges.

Is the interpretation of fisher habitat requirements reasonable?

The relationship between home range size and quality of habitat has not been proven, in part because of the difficulty in defining quality habitat for fisher.

Data of Truex et al. (1998) are conflicted as to whether Eastern Klamath home range is poorer quality habitat. For example, fisher capture rates in the Eastern Klamath are comparable to other studies (when only initial rates are used). Demographic profiles where data were available

did not confirm poorer habitat quality (e.g., fisher survivorship was higher in some measures; reproduction undetermined). Some evidence suggests that the Eastern Klamath may be higher quality habitat because fishers there had larger body size, higher survival rates, and higher proportion of juveniles in the population. Factors other than rest site selection, such as higher prey abundance or availability, may have influenced demographic parameters.

“Based on a review of eight studies of fisher home-range size, Freel determined that supporting a reproductive unit of fishers, including the home ranges of one male and two females, would require [6,000 ac] in high capability habitat with 70-80 percent in mature, closed conifer forest; [9,800 ac] in moderate capability habitat with 61-80 percent in mature, closed conifer forest; and [11,300 ac] in low capability habitat with 50-60 percent in mature, closed conifer forest.”
(CBD 2008; page 12)

Does this statement in the listing petition accurately reflect the literature cited?

Freel (1991): The petitioners fail to mention that, according to Freel, “Many of the parameters use assumptions derived from [USDI Fish and Wildlife Service Habitat Suitability Models (HSI) for fisher] and, therefore, will require field verification.” For example, he presents home range estimates by “habitat capability”; however, area estimates are based on national averages, and contain huge assumptions about number of individuals in a home range and home range overlap among them; and he assumed that California habitat is high quality because the home ranges are smaller than found by other studies elsewhere, without testing the assumption about habitat quality. The HSI models for fisher focus on denning and resting habitat structures, and provide little solid guidance for characterizing fisher habitat at the forest stand or home range scales (i.e., minimum stand size, forest structure, etc.). Regarding assumptions for “mature, closed forest,” Freel stated, “in all cases, the highest number of acres of the highest quality habitat capability are used,” and that “current information from Maine and Canada suggests that fisher may utilize second growth more than indicated in this table”; also that “as more local data become available, the percentages of old/mature to second growth may change although the need for good canopy closure (>40%) still applies equally for all seral stages.”

The author assumed that forest areas with canopy closure greater than 30% provide suitable foraging habitat.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

This citation proposing forest management guidelines is 17 years old. Many scientific studies and reviews of fisher habitat preferences have been undertaken since Freel prepared this report.

Is the interpretation of fisher habitat requirements reasonable?

No. The Freel literature review was used by the USDA Forest Service to draw numerous assumptions for forest management objectives that might benefit fisher. The management assumptions, now 17 years old, are not directly supportable by the scientific literature; many are based on ecological generalities, assumed optima, or force-fitted to formulate management direction. For example, the relationship between home range size and quality of habitat has not been proven, in part because of the difficulty in defining quality habitat for fisher.

“At the landscape scale, fisher distribution was strongly associated with landscapes with high levels of tree canopy cover.”
(CBD 2008; page 12)

Does this statement in the listing petition accurately reflect the literature cited?

Carroll et al. (1999): Yes, the authors found that tree canopy closure is significantly correlated with fisher presence. However, canopy cover alone is not a predictor of stand age or forest structure. In fact, the authors found that tree size is negatively correlated with fisher presence. This finding appears to conflict with fine scale studies by others focusing on denning and resting sites, and might be attributable to characteristics of mixed forests that have high canopy closure in younger stands. Tree size has a complex effect and interpretability is limited.

Two-thirds of variance in fisher distribution was still unexplained in two model sets after accounting for tree canopy closure, percent conifer, and the negative effect from tree size.

Is there scientific literature relevant to this habitat claim that the listing petition failed to cite?

Numerous researchers have reported that fishers seem to prefer contiguous forests with good cover; however, quality cover can be found in managed and disturbed landscapes, forests of various ages, shrubland, and areas with complex understory structure (e.g., Weir and Harestad 2003; Buskirk and Powell 1994).

Is the interpretation of fisher habitat requirements reasonable?

Yes. When the authors studied response of fishers to regional habitat data at a scale closer to fisher home range, rather than stand- or plot-level data, they found that canopy cover is more important to fisher presence than tree size or forest age; although fishers use older forest structures for denning and resting.

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