Conservation of Fishers *(Martes pennanti)* in South-Central British Columbia, Western Washington, Western Oregon, and California

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Team Leaders:

Laura L. Finley and Robert H. Naney

Interagency Fisher Biology Team:

Peg Boulay (Oregon Department of Fish and Wildlife)
Esther Burkett (California Department of Fish and Game)
Laura L. Finley (USDI Fish and Wildlife Service, Pacific Southwest Region)
Linda J. Hale (USDI Bureau of Land Management, Oregon)
Patricia J. Happe (USDI National Park Service)
J. Mark Higley (Hoopa Tribal Forestry)
Arlene D. Kosic (USDI Bureau of Land Management, California)
Amy L. Krause (USDI Bureau of Land Management, California)
Jeffrey C. Lewis (Washington Department of Fish and Wildlife)
Susan A. Livingston (USDI Fish and Wildlife Service, Pacific Region)
Eric C. Lofroth (British Columbia Ministry of Environment)
Diane C. Macfarlane (USDA Forest Service, Pacific Southwest Region)
Anne Mary Myers (Oregon Department of Fish and Wildlife)
Robert H. Naney (USDA Forest Service, Pacific Northwest Region)
Catherine M. Raley (USDA Forest Service, Pacific Northwest Research Station)
Richard L. Truex (USDA Forest Service, Pacific Southwest Region)
J. Scott Yaeger (USDI Fish and Wildlife Service, Pacific Southwest Region)

Front Cover Photo:

Greg Trouslot

Back Cover Photo:

Olympic Fisher Project

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USDI Bureau of Land Management, National Operations Center, Denver, Colorado

APPENDIX 1

Fisher Threats Workshop Report

Bruce G. Marcot, USDA Forest Service,
PNW Research Station
Steve Morey, USDI Fish and Wildlife Service,
Science Support Program
Bob Naney, USDA Forest Service,
Okanogan/Wenatchee NF
Laura Finley, USDI Fish and Wildlife Service,
Yreka Fish and Wildlife Office

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Summary

The Fisher Conservation Strategy Biology Team (fisher biology team) held an "expert panel" workshop on February 6–8, 2007, to conduct a "threats analysis" for fishers within the West Coast Distinct Population Segment (DPS) and British Columbia. The fisher biology team, rank-ordered the 20 types of threats (Table 1) previously identified as having the potential to influence fisher populations and fisher life-history attributes (Table 2). Overall, the fisher biology team ranked the greatest threats to be uncharacteristically severe wildfire, overstory reduction, reduction of structural elements, and forest habitat fragmentation (not listed here in any specific order), although the severity of threats varied by geographic areas (as defined in the draft Interagency Fisher Conservation Assessment). The team expressed the greatest uncertainty (differences of threat scores) for effects of understory reduction, reduction in vegetation diversity, forest habitat fragmentation, and uncharacteristic forest insect and disease

The fisher life history attributes (Table 2) that the team deemed to be most severely affected by more than half of the 20 types of threats included home range establishment and prey availability. However, all of the fisher life history attributes were thought to be influenced by at least one of the threat categories.

This workshop was designed to provide a structured process for assessing threats, not for providing decisions. As such, the results identify areas of uncertainty or information gaps and plausible working hypotheses about threats to fishers. The results also provide an initial basis for ranking of the most important threats and developing conservation actions. Outcomes are displayed with all the team's rank values and are summarized into three classes based on equal divisions of the possible ranks (0–10), although the classes are not intended to suggest that any threat categories be omitted from further consideration. The next phase of the project may entail interpreting the threat rankings to devise conservation strategies for reducing threats.

Methods

Definitions of Terms

Prior to the meeting, the fisher biology team had compiled and defined a list of 20 potential threat sub-categories organized into 6 general categories (linear features, human-caused mortality and/or reduction in fitness, development, wildfire and fire suppression, vegetation management for fuels reduction or timber production, and miscellaneous). Most, but not all, of the threat sub-categories were anthropogenic in nature. The term "threat" was defined as any of the effects on fisher life history attributes that may result in fishers not being sustainable in the geographic area being assessed.

The list of fisher life history attributes developed for the workshop was based on the known biology and ecology of fishers. These attributes were used to

assist panelists with considering both the intensity and scale of the potential effects of the threat sub-category.

The team also delineated 11 geographic areas ranging from British Columbia to the southern Sierra Nevada Mountains of California, within which each threat sub-category would be evaluated. Of the 11 geographic areas, three currently contain extant populations of native west coast fisher (northern California extending into southwest Oregon, the currently-occupied portion of the southern Sierra Nevada, and British Columbia). In addition the Cascade Mountains of southern Oregon contains an reintroduced population. The remainder of the DPS is considered to be currently unoccupied but presumed occupied historically.

Expert Panel Procedures

The threat evaluation took the form of an expert panel, using the team members as species, geographic and subject-area experts. Thirteen of the 14 total team members were present and participated in the expert panel session. Team members knowledgeable about each geographic area were present. The meeting began with a review of all terms for threat sub-categories (Table 1), definitions of threat, fisher life history attributes (Table 2), and delineations of each geographic area (Table 3) .

Marcot and Morey moderated the panel using a Delphi procedure, which entailed the following steps. In the first step, the team members were asked to silently record a score value that represented the effect of each threat sub-category on fisher populations in each of the geographic areas. The score values were integers ranging from 0 to 10, where 0 = no threat, 10 = maximum threat, and intermediate values were graded according to relative, perceived threat levels. The team members were directed to independently score each threat sub-category by geographic area rather than rank-ordering geographic areas with each threat sub-category. After a group discussion, the geographic areas classed as unoccupied by fisher were scored as if one-third of the potential fisher habitat within the geographic area was occupied

The panelists also denoted which fisher life history attributes might be adversely affected by each threat sub-category; this was not scored on a scale, but merely denoted by a checkmark if an effect was expected. This revealed how each team member, while evaluating each threat sub-category, conceptualized how the threat was affecting aspects of fisher biology.

In the second step, the panel engaged in a moderated disclosure of their first-round threat scores. This allowed each panelist to articulate reasons for their scoring, to hear how and why others scored as they did, and to briefly ask each other clarification questions. Each panelist also briefly noted which fisher life history attribute is influenced by each threat sub-category.

In the third step, each team member conducted a second-round, silent, final scoring of threat effects on fisher populations by geographic area (using 0–10 scoring) and on fisher life-history attributes (denoting expected effects just with a checkmark). In both the first-round and second-round scoring, we allowed the panelists to pass on denoting threat scores if they felt they had poor to no experience or information on a threat sub-category for a particular geographic area.

Analysis of Results

From both the first-round and second-round scoring of threats, we entered the individual panelists' threat scores and threat-life history attribute effects into a spreadsheet.

We summarized the threat scores for combinations of threat sub-categories and geographic areas in the following ways: sample size of number of voting team members, median score values, and minimum, maximum, and range (maximum minus minimum)

of score values. The median score values displayed central tendencies of the panel as a whole, and the range of score values displayed the degree of variation and uncertainty among panelists. High ranges of score values among panelists suggested greater levels of variation and uncertainty among the panelists.

We color-coded the summaries of median and range of threat scores to help simplify interpretation of potential priorities of threat sub-categories. The mean threat scores were color-coded into high, moderate, and low levels, where high = threat scores 7–10, moderate = 4–6, and low = 0–3. The range of threat scores were also color-coded into high and low range values, where high = >5 and low is 5 or less. However, we retained and displayed the actual median and range values to allow exploration of different cutoff values for evaluating threat scoring outcomes.

We summarized the 13 team members' denoting of effects of threat sub-categories on fisher life history attributes by tallying the number of panelists that checked each combination. Higher tallies suggested greater consistency in how panelists thought that a threat sub-category might adversely affect fishers. We color-coded these tallies into high (8–13), moderate (4–7), and low (0–3) levels but also provide actual tallies if different cutoff values or if a different number of levels were desired.

Only the final, second-round scores are analyzed and presented in the following section.

Results

Threats by Score Levels

The median values of threat scores (Table 4) suggested that the threat sub-categories with the highest scores in at least four of the geographic areas (red cells in Table 4) were uncharacteristically severe wildfire, overstory reduction, reduction of structural elements, and fragmentation (listed here in the order they appeared in the tables). Other threat sub-categories with moderate median score levels (Table 4) in at least four of the geographic areas included forest roads and other linear features, understory reduction, reduction in vegetation diversity, and uncharacteristic forest insect and disease. The remaining threat sub-categories either had variable moderate and low median scores, or more consistently low median scores, among the geographic areas.

Levels of Uncertainty Regarding Threat Sub-categories

Threat sub-categories garnering the greatest range in panelists' score values, and thus implying a greater level of uncertainty among panelists (shown in Table 5 as dark gray cells for four or more geographic areas) included understory reduction, reduction in vegetation diversity, fragmentation, and uncharacteristic forest insect and disease. It is noteworthy that, of this list, only fragmentation was ranked high in median scores. The rest of the threat sub-categories listed above as having highest median threat scores garnered low ranges of score values, which may mean that they were most consistently understood and scored by the panelists.

Effects of Threats on Fisher Life History Attributes

Tallies of threat sub-categories by fisher life history attributes (Table 6) suggest that most of the threat sub-category have unique effects on fisher populations. The threat sub-categories having the highest tallies (red cells in Table 6) on more than half of the life history attributes included urbanization, uncharacteristically severe wildfire, overstory reduction, reduction of structural elements, and fragmentation. However, each threat sub-category had a highest effect on at least one of the fisher life history attributes; there was no completely benign threat sub-category.

The fisher life history attributes affected by more than half of the threat sub-categories included home range

establishment and prey availability. However, each of the fisher life history attributes was most affected by at least one of the threat sub-categories.

Discussion and Interpretation

Results of this evaluation of threats on fisher populations should be interpreted as a survey of informed expert judgment. The panelists became informed by studying journal articles and reports on fisher ecology, biology, and conservation; by listening to presentations by expert researchers; and, for some panelists, by having conducted surveys or research on fishers directly. In this way, and by dint of the formal Delphi panel method used, results constitute far more than guesses or subjective opinions.

However, the ranking of threat sub-categories by geographic area or by range of uncertainty nonetheless are derived from querying the knowledge and judgment of experts, not from direct empirical field data per se. Thus, results might be better interpreted as providing plausible and potentially testable working hypotheses, and providing a basis for building conservation measures and actions that could prioritize addressing higher-scoring threats.

Cutoff values – the color-coded groupings shown in Tables 4–6 – were intended to guide understanding of the score values, not to provide definitive thresholds of effects. To this end, we have also displayed actual score values, if users of this information wish to use different cutoff values or numbers of categories, for prioritizing threats. The authors of this report have retained in a spreadsheet the individual threat scores of each panel member, available upon request.

Table 1. Categories, sub-categories, and definitions of threats used in the fisher threat assessment.

Threat Category	Threat Sub-Category	Definition
Linear features	Major highways	Multi-lane highways, generally > 55mph
	State highways	Two-lane state highways
	Forest roads (paved/gravel/dirt), utility corridors, canals, pipelines, railroads, etc.	All forest roads and other linear features
Human caused mortality and/or reduction in fitness	Lethal events/activities	Hunting, incidental trapping, poaching, poisoning, water tanks, fur trapping (cultural, recreational, and profit)
	Sub-lethal events/activities	Poisoning, research activities, domestic dogs, secondary effects from predator control, animal damage control
	Activities that affect behavior	OHV/OSV vehicles, other mechanical noise, people recreating and smoke
Development	Urbanization (rural/residential)	Installation of new rural/residential structure and infrastructure
	Agriculture	Conversion of forest to agriculture
	Large reservoirs	inundation
	Non-timber resource extraction	Mining, oil, etc
	Recreation	Ski area development, cabins, trails, campgrounds
Wildfire / fire suppression	Uncharacteristically severe wildfire	Probability of fire outside the range of variation (larger in both size and intensity)
	Suppression and rehabilitation activities	Snag felling, backfires, fuel breaks, fire lines
Vegetation management: fuels reduction, timber production	Overstory reduction	Dominant and co-dominant trees; differentiate in comments canopy vs. stem density
	Understory reduction	Loss of shrubs, saplings, intermediate, and suppressed trees, structural diversity
	Reduction of structural elements	Reduction in occurrence of mistletoe, heart rot, pest/disease; reduction in large down wood
	Reduction in vegetation diversity	Floristic/tree species diversity
Miscellaneous	Fragmentation	Pattern, distribution, and patchiness of environments and habitats used by fishers
	Climate change	Potential changes to vegetation communities, fire frequency and fire intensity
	Uncharacteristic forest insect & disease	Sudden oak death, mountain pine beetle, etc

Table 2. List and definitions of fisher life history attributes used in the fisher threat assessment.

Fisher life history attribute	Definition
Mortality	Death of an individual
Survival	Able to meet all requisite annual life history needs; living to full life expectancy
Reproduction	Successfully breeding and producing young.
Recruitment	Young survive to reproductive age and produce offspring
Disease	Virus, bacteria, fungus, parasites that weaken individuals
Daily movement	Average movements an individual makes in a 24-hour period
Breeding season movement	Movements males and/or females make during the breeding season
Dispersal movements	Movements, generally by subadults, away from parent home range to establish new home range
Home range establishment	Stable area where individuals are able to meet daily and annual life requirements
Prey availability	Fisher prey available in an environment in which they can safely and successfully hunt.
Predation	Killed by other wildlife species
Competition	Species present that compete for food and habitat with fishers.

Table 3. List and definitions of geographic areas used in the fisher threat assessment. Occupancy status refers to whether fisher are currently present, introduced, or absent.

Geographic area name (occupancy status)	Definition
So. BC (unoccupied)	Area between the Fraser and Thompson Rivers and the Okanagan Country. The Fraser lowlands are permanently alienated.
WA- Coastal (unoccupied)	Canadian border to Oregon border and west of Highway 101 and Interstate 5. Includes the Olympic Peninsula
WA East Cascades (unoccupied)	Cascade Mountains. Canadian border to the Oregon border east of the Cascade Mountain crest.
WA West Cascades (unoccupied)	Cascade Mountains. Canadian border to the Oregon border west of the Cascade Mountain crest to Interstate 5
OR - Coastal (unoccupied)	Interstate 5 west from the Columbia River to the California border
OR East Cascades (unoccupied)	Cascade crest east in the Cascade Mountains. The Willamette Valley proper is outside of fisher habitat.
OR West Cascades (unoccupied)	Interstate 5 east to the Cascade crest
OR (introduced)	Primarily on the Rogue River National Forest, Jackson Co., Oregon
NW CA & SW OR (extant)	Oregon south of hwy 199, Lassen west to coast, South into Lake County.
Sierra (unoccupied)	Lassen south to central Yosemite
Sierra (extant)	South of central Yosemite.

Table 4. Results of Team scoring of threat sub-categories by geographic area. Values shown are median threat scores among 13 panelists. Threat scores ranged 0–10, where 0 = no threat and 10 = maximum threat on fisher populations. Higher median score values suggest more salient effects of a threat sub-category on fishers.

Threat	Threat Sub-Category	So. BC (unoccupied)	WA - Coastal (unoccupied)	WA East Cascades (unoccupied)	WA West Cascades (unoccupied)	OR - Coastal (unoccupied)	OR East Cascades (unoccupied)	OR West Cascades (unoccupied)	OR - (introduced)	NW CA & SW OR (extant)	Sierra (unoccupied)	Sierra (extant)
Linear features	Major highways	3	2	2	3	2	1	2	1	2	2	0
	State highways & paved forest roads	3	3	3	3	3	3	3	2	2	5	3
	Forest roads (gravel/dirt), utility corridors, canals, pipelines, railroads, etc.	4	4	3	4	4	3	4	3	4	5	4
Human caused mortality and/or reduction in fitness	Lethal events/activities	7	2	2	2	3	3	3	4	3	4	3
	Sub-lethal events/activities; related to rural interface	2	2	2	2	2	2	2	3	2	3	2
	Activities that affect behavior	2	2	2	3	2	2	2	3	2	4	2
Development	Urbanization (rural/residential)	2	3	2	4	3	3	3	2	2	5	2
	Agriculture	1	1	1	1	2	1	2	1	1	2	1
	Large reservoirs	1	1	1	1	1	1	1	1	2	1	1
	Non-timber resource extraction	1	1	1	1	1	1	1	1	1	1	1
	Recreation	1	2	2	3	2	2	2	2	2	4	3
Wildfire / fire suppression	Uncharacteristically severe wildfire	5	2	7	2	4	7	4	5	7	7	8
	Suppression and rehabilitation activities	2	2	3	2	3	3	3	3	3	3	4
Vegetation management: fuels reduction, timber production	Overstory reduction	7	7	6	6	8	6	7	5	6	7	6
	Understory reduction	5	5	5	4	6	6	5	5	5	5	5
	Reduction of structural elements	8	8	7	7	7	6	7	6	6	7	6
	Reduction in vegetation diversity	4	5	4	4	5	4	5	4	5	4	4
Miscellaneous	Fragmentation	7	7	6	6	8	6	6	5	6	8	6
	Climate change	5	2	4	3	3	4	3	3	3	5	5
	Uncharacteristic forest insect & disease	6	2	4	2	2	4	2	1	5	4	4

threat levels 7–10 threat levels 4–6 threat levels 0–3

Table 5. Results of Team scores of threat sub-categories by geographic area. Values shown are ranges of score values (maximum minus minimum score values) among panelists. Higher range values suggest greater variation or uncertainty of threat scores among panelists.

Threat	Threat Sub-Category	So. BC (unoccupied)	WA - Coastal (unoccupied)	WA East Cascades (unoccupied)	WA West Cascades (unoccupied)	OR - Coastal (unoccupied)	OR East Cascades (unoccupied)	OR West Cascades (unoccupied)	OR - (introduced)	NW CA & SW OR (extant)	Sierra (unoccupied)	Sierra (extant)
Linear features	Major highways	4	3	4	4	4	1	3	3	5	3	2
	State highways & paved forest roads	3	4	4	4	4	5	5	3	3	3	3
	Forest roads (gravel/dirt), utility corridors, canals, pipelines, railroads, etc.	4	4	4	4	4	3	4	3	3	6	3
Human caused mortality and/or reduction in fitness	Lethal events/activities	4	3	3	3	6	4	5	4	4	4	5
	Sub-lethal events/activities; related to rural interface	4	2	4	3	3	4	5	4	3	4	4
	Activities that affect behavior	4	3	4	4	4	3	3	3	3	2	3
Development	Urbanization (rural/residential)	2	3	3	5	4	6	4	2	3	5	2
	Agriculture	3	4	3	3	5	2	2	3	3	3	4
	Large reservoirs	6	2	4	3	2	2	3	2	4	4	3
	Non-timber resource extraction	2	2	3	2	3	3	2	2	2	3	2
	Recreation	7	3	4	3	5	4	3	6	3	4	5
Wildfire / fire suppression	Uncharacteristically severe wildfire	6	6	5	5	3	4	4	5	4	5	4
	Suppression and rehabilitation activities	5	3	3	4	4	4	4	4	4	3	3
Vegetation management: fuels reduction, timber production	Overstory reduction	3	6	5	2	4	5	3	6	4	3	4
	Understory reduction	6	8	3	4	5	6	6	4	3	4	6
	Reduction of structural elements	5	5	6	3	5	5	4	7	3	5	4
	Reduction in vegetation diversity	5	8	6	6	6	5	3	7	5	3	3
Miscellaneous	Fragmentation	5	6	5	5	4	6	5	7	6	5	6
	Climate change	5	5	5	4	5	5	4	4	6	5	5
	Uncharacteristic forest insect & disease	4	4	4	4	4	7	5	5	6	6	6

high range (spread of threat scores >5) high range (spread of threat scores <=5)

Table 6. Tally of panelist scores of potential adverse influence of threat sub-categories on fisher life history attributes. Total possible score is 13 (with 13 panelists).Higher tallies suggest greater consistency in panelists' interpretation of how a threat sub-category can adversely affect fisher populations.

		Fisher Life History Attributes											
Threat	**Threat Sub-Category**	**Mortality**	**Survival**	**Reproduction**	**Recruitment**	**Disease**	**Daily movement**	**Breeding season movement**	**Dispersal movements**	**Home range establishment**	**Prey availability**	**Predation**	**Competition**
Linear features	Major highways	13	6	3	6	0	6	9	13	8	0	0	0
	State highways & paved forest roads	13	7	2	2	0	7	7	7	9	0	0	0
	Forest roads (gravel/dirt), utility corridors, canals, pipelines, railroads, etc.	9	5	1	2	3	9	4	5	6	2	10	2
Human caused mortality and/or reduction in fitness	Lethal events/activities	13	6	3	5	2	1	0	0	0	0	0	0
	Sub-lethal events/activities; related to rural interface	3	8	10	9	6	5	0	0	0	3	3	2
	Activities that affect behavior	0	4	8	5	2	12	5	4	8	4	4	2
Development	Urbanization (rural/residential)	4	6	3	4	9	6	10	11	13	12	9	8
	Agriculture	3	5	3	3	5	7	8	11	13	12	7	6
	Large reservoirs	0	3	4	4	0	6	10	10	11	6	0	1
	Non-timber resource extraction	3	3	2	4	0	8	5	6	9	3	0	0
	Recreation	0	2	3	2	3	10	7	4	9	4	5	3
Wildfire / fire suppression	Uncharacteristically severe wildfire	11	10	10	10	2	11	13	12	13	10	9	9
	Suppression and rehabilitation activities	4	2	9	7	0	8	2	1	4	9	4	1
Vegetation management: fuels reduction, timber production	Overstory reduction	4	9	13	11	0	10	5	7	13	9	10	8
	Understory reduction	0	4	1	2	0	8	1	1	4	13	9	5
	Reduction of structural elements	3	8	13	10	0	10	3	2	12	9	8	4
	Reduction in vegetation diversity	1	9	9	7	0	1	2	0	9	13	4	7
Miscellaneous	Fragmentation	2	11	9	10	0	12	13	13	13	7	11	10
	Climate change	2	6	5	4	2	4	4	5	12	12	6	8
	Uncharacteristic forest insect & disease	0	5	9	7	0	1	2	4	9	10	5	1

"high," scores 8–13 "moderate," scores 4–7 "low," scores 0–3