CHAPTER 5

Risk Analysis of Species in Old-Growth Forests of the Pacific Northwest: Viability Assessment and Mitigation Measures in National Forests

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CHAPTER 5

Risk Analysis of Species in Old-Growth Forests of the Pacific Northwest: Viability Assessment and Mitigation Measures in National Forests

INTRODUCTION

Court Order

This chapter addresses the portion of the United States District Court order to evaluate the effect of proposed management strategies for the northern spotted owl (*Strix occidentalis caurina*) in National Forests on viability of other species of plants and animals closely associated with old-growth forests. Specifically, the Scientific Analysis Team's tasks were: (1) to determine if the alternatives for management of northern spotted owl habitat as presented in the Forest Service's Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests (USDA 1992c)(hereafter referred to as the Final Environmental Impact Statement) would allow alterations of habitat that would result in the extirpation or extinction of any of the 32 vertebrate species associated with old-growth forest in National Forests within the range of the northern spotted owl, as identified in the Final Environmental Impact Statement and in the Judge's order; and (2) if analyses indicate low viability ratings for such other species as a result of the proposed actions, to propose appropriate mitigating options (Forest Service letters of direction dated July 30, 1992 and August 28, 1992; see Chapter 2, Appendix 2-A).

Framework for Assessment

Our evaluation of species associated with old-growth forests and their viability entailed three phases:

Identification of species closely associated with old-growth forests and components of old-growth forests;

Evaluation of the viability of each of these species, under each of the five alternatives in the Final Environmental Impact Statement, including estimating the likelihood of extirpation from planning areas (i.e., National Forests) within the range of the northern spotted owl; and

Identification of mitigation options to ensure a high likelihood that each species would not be extirpated from planning areas within the range of the northern spotted owl as a result of Forest Service actions.

This process also entailed identifying scientific uncertainties and key unknowns that could influence the viability evaluations of old-growth forest species. Such unknowns included identifying species about which little or no scientific information on ecology, life history, and habitat relationships is available.

Risks to each species associated with old-growth forests in terms of extirpation and viability were judged by the alternatives in the Final Environmental Impact Statement. In estimating habitat associations and risks of extirpation, the Scientific Analysis Team was not expected to conduct a formal viability assessment for each forest species associated with old-growth forests. Rather, we were directed to use common sense and expert judgment and to explicitly display and discuss the process used for establishing viability ratings (Forest Service letter of direction dated August 28, 1992; see Chapter 2, Appendix 2-A; also see court order discussed in Chapter 1).

METHODS

Description of the Northern Spotted Owl Final Environmental Impact Statement

Viability of species closely associated with old-growth forests was evaluated under each of the five planning alternatives presented in the Final Environmental Impact Statement. These alternatives applied only to National Forests. They were:

A - Spotted Owl Habitat Areas
B - Interagency Scientific Committee's Conservation Strategy (Thomas et al. 1990)
C - Interagency Scientific Committee's Conservation Strategy plus Fish and Wildlife Service's (USDI) critical habitat designated for the northern spotted owl
D - Interagency Scientific Committee's Conservation Strategy plus all additional nesting, roosting, and foraging habitat for northern spotted owls
E - The Multi-Resource Strategy

Standards and Guidelines of the Selected Alternative

The selected alternative in the Final Environmental Impact Statement was Alternative B-the Interagency Scientific Committee's Conservation Strategy. This strategy entails designation of Habitat Conservation Areas to encompass nesting, roosting, and foraging habitat for the northern spotted owl throughout its range in National Forests (see Chapter 3).

In addition, the forest "matrix" (lands between the Habitat Conservation Areas) are to managed to provide for northern spotted owl dispersal habitat. Management guidelines for providing dispersal habitat are termed the "50-11-40 rule" (Thomas et al. 1990). This standard provides for each quarter-township outside of Habitat Conservation Areas in National Forests and other Federally administered public lands within the range of the northern spotted owl, at least 50 percent of the forested land base in forest stands averaging at least 11 inches diameter at breast height (dbh) and at least 40 percent canopy closure. Also, the Interagency Scientific Committee's Conservation Strategy calls for the retention of other land allocations that also provide for old-growth forest cover, as identified in each National Forest Land and Resource Management Plan.

Old-Growth Species Identified in the Final Environmental Impact Statement

The Final Environmental Impact Statement identified 32 species of terrestrial vertebrate wildlife (amphibians, reptiles, birds, and mammals) that are closely associated with late-successional or old-growth forests or components of old-growth forest (see Final Environmental Impact Statement, Volume 1, p. 3~4-136, Table 3&54-30, "Species Closely Associated With Late-Successional Forest"). Our analysis refined the basis for evaluating the degree of association of these species with late-successional and old-growth forests, and expanded the evaluation to include fungi, lichens, plants, invertebrates, and fish, in addition to all terrestrial vertebrates.

Why Evaluate All Species Groups?

We considered a wider range of plant and animal species than that presented in the Final Environmental Impact Statement for three primary reasons. First, selecting and implementing a spotted owl habitat management plan is best conducted from a base of full disclosure and knowledge of potential effects of that plan on all species. Second, assessing effects on a broad variety of species groups better meets agency direction to provide for, and evaluate impacts on, the full range of biological diversity. Third, such a comprehensive approach lays the groundwork for a more complete approach to ecosystem management. Identification of effects on, and mitigation options for, individual old-growth species is still but one step in ecosystem planning. We do not intend for this assessment to substitute for a complete ecosystem analysis; it is, however, a vital and major step toward such an analysis.

Furthermore, the Court identified that "Congress's mandate for multiple use, including both logging and wildlife preservation, can be fulfilled if the remaining old-growth habitat is left standing; it cannot be if the old growth in any National Forest is logged to the point where native vertebrate species cease to exist there" (Judge Dwyer's ruling of July 2, 1992). Our assessment was conducted to help the Forest Service determine steps necessary to safeguard the security of old-growth forest species occurring within the range of the northern spotted owl.

Selection of Old-Growth Species

The following procedure was used to identify species closely associated with old-growth forests. We compiled a "long list" of species that occur within late-successional forests (mature or old growth, as defined by Ruggiero et al. 1991, Brown 1985, USDI 1992a). This long list was narrowed to a "short list" of species closely associated with old-growth forests or with components of old-growth forests. Each species on this short list was then evaluated for viability under the Final Environmental Impact Statement alternatives, and subset lists of species with risk to viability were identified. Also, species were identified that are so poorly known scientifically that viability could not be judged. Mitigation options for the species with risk to viability were then identified. Specifically, each step in this process was conducted as follows.

"Long List" of Species That Use Mature and Old-Growth Forests - First, we identified all plant and animal species that might find optimal habitat within late-successional forests in National Forests within the range of the northern spotted owl. In this step, we reviewed available summaries of literature on species distribution by forest condition and age class (see literature cited in Appendix 5-A). We also accessed unpublished studies and data, existing Forest Service data bases (ecology data bases), and used professional knowledge to compile the long lists plants. The technical and scientific literature contains many references on species occurring in

late-successional forest (see citations in Appendix 5-A). We did not attempt to review every existing piece of primary literature; rather, we focused on the major syntheses of mature and old-growth species lists most often cited and used by resource managers and biologists (Appendix 5-A). Of particular importance in building the long lists were the recent publications of Ruggiero et al. (1991) and the Draft Recovery Plan for the Northern Spotted Owl (USDI 1992a).

We compiled a composite list of all species that were depicted in one or more of these references as using late-successional forests within the range of the northern spotted owl for at least one aspect of their life history. This resulted in a "long list" of plant and animal species found in late-successional forests (see Appendix 5-A). A long list of 7 anadromous fish species consisting of 214 stocks, and an additional 4 species of resident fish, were considered by the fish habitat experts on the Scientific Analysis Team. A stock is a locally adapted population that is, for the most part, reproductively isolated from other stocks (Packer 1972). Individual stocks have been recognized for listing under the Endangered Species Act (National Marine Fisheries Service 1990). In this report, conservation mitigation options focused on the identified stocks.

"Short List" of Species Closely Associated With Old-Growth Forests - We then developed a set of criteria by which each species on the "long list" was further evaluated for its degree of association with old-growth forest ecosystems (Table 5-1). Not all species on the long list are closely associated with old-growth forests; some species also occur commonly in young-growth forests, or in other special habitat Conditions. The criteria we developed helped identify those species that are associated with old-growth forest stages and old-growth forest components such as large snags and large down logs plus those species identified by state or Federal agencies as proposed or listed as threatened or endangered. The criteria helped us to produce a "short list" of species likely to be closely associated with old-growth forests or components of old-growth forests (see Appendices 5-B, 6-C, 6-D; also, Appendix 5-A shows how the criteria were applied to each species of terrestrial vertebrate on the long list).

Components of old-growth forests considered in this evaluation included large diameter snags, large diameter and very old live trees, large amounts and sizes of down wood, and deep litter and duff layers on the forest floor. We explored species' use of old-growth forest components because these are elements of forest ecosystems that possibly could be provided outside old-growth forests per se by use of innovative silviculture. These old-growth forest elements are key to the dispersal and distribution of some species across the general forest landscape.

Table 5-1 Criteria for Developing the List of Species Closely Associated With Old-Growth Forests or Components of Old-Growth Forests ("Short List"), From the List of Species That Least Occur Within Old Growth ("Long List").

Criteria

A species is included in the short list of species closely associated with old-growth forests or components if it meets at least one of the following 4 criteria:

Criterion 1: - The species is statistically significantly more abundant (based on field study or collective professional judgment of the Scientific Analysis Team) in old-growth forest than in pole or mature forest, in any part of its range.

Criterion 2: - The species shows association with old-growth forest (may reach highest abundance there, but not necessarily statistically so) and the species requires habitat components that are contributed by old-growth forest (based on field study or collective professional judgment of the Scientific Analysis Team).

Criterion 3: - The species is associated with old-growth forest (based on field study) and is on Federal (Fish and Wildlife Service) or state threatened and endangered List, on the Fish and Wildlife Service Candidate Species List, Forest Service Regions 5 or 6 Sensitive Species List, or listed by Washington, Oregon, or California as species of special concern or sensitive species.

Criterion 4: - Field data axe inadequate to measure strength of association with old-growtli forest, and the species is listed as a Federal (Fish and Wildlife Service) threatened and endangered, and Scientific Analysis Team suspects that it is associated with old-growth forest.

Specific Factors

Following are specific factors extracted from the above list of criteria. These factors were identified for e~ch terrestrial vertebrate species (amphibians, reptiles, birds, and mammals) on the long list (see Appendix 5-A; similar procedure was used for plant species and fish stocks, not shown in the appendices).

Factor A- -Field data: species is significantly more abundant in old-growth forest than in younger forest based on field data.

Factor B- -Scientific Analysis Team judgment: species is significantly more abundant in old-growth forest than in younger forest based on collective professional judgment of the Scientific Analysis Team.

Factor C- -Association with old-growth forest: species is associated with old-growth forest (may reach highest abundance there, but not necessarily statistically so).

Factor D- - Associated with old-growth forest elements: species is associated with habitat elements that are contributed by old-growth forest (based on field study or collective professional judgment of the Scientific Analysis Team).

Factor E- -Federal Fish and Wildlife Service threatened and endangered: species is on Federal (Fish and Wildlife Service) list of threatened or endangered species.

Factor F- -Federal Fish and Wildlife Service Candidate: species is on Federal Fish and Wildlife Service Candidate Species List.

Factor G- -Forest Service Sensitive Species: species is on Forest Service Region 5 or 6 Sensitive Species List.

Factor H- -State list: species is on state list (threatened and endangered, sensitive, special concern) Washington, Oregon, or California.

Factor I- -Inadequate field data: unaware of adequate field data by which to measure (quantify) strength of association with old-growth forest.

Table 5-1 (continued) Criteria for Developing the List of Species Closely Associated With Old-Gr0wth Forests or Components of Old-Growth Forests ("Short List"), From the List Species That at Least Occur Within Old Growth ("Long List").

Rule Set for Determining "Short List"

Relating factors to criteria - a species qualifies as a ~short llsts species under a given criterion if it strictly meets the following factor conditions:

Meets Criterion 1 if meets: Factor A or B.
Meets Criterion 2 if meets: Factors C and D.
Meets Criterion 3 if meets: (Factor A or C) and (E or F or G or H)
Meets Criterion 4 if meets: Factors E and I and (A or B or C or D).

Assessment of Viability Effects

Population viability analysis can be a complex series of quantitative evaluations. It can involve field data on demography and trend of populations, calculations of loss of genetic variation, and simulation models projecting habitat conditions, population responses, dynamics of metapopulations (interacting populations), and complicating, cumulative effects of other biological and nonbiological factors. Our evaluation of potential viability of old-growth species is not a quantitative population viability analysis. We lack data and specific models of habitats and populations by which to quantify likelihoods of extirpation and continued existence. Our emphasis was qualitative and focused on amount and distribution of habitat provided under planning alternatives. Given more time, we could have considered additional primary literature on some species. However, there are few basic scientific studies on life history and ecological requirements of most species examined.

Based on our collective professional judgment and that of the expert review panels (see below), we qualitatively considered potential future effects Of natural catastrophes and disturbances on species viability. However, because of lack of time and available models, we did not quantify and predict specific aspects of ecosystem process and function, such as by analyzing the type, frequency, and potential effects of disturbance events (i.e., fires, windstorms, outbreaks of forest pathogens, and natural succession). Thus, the viability evaluations presented should be interpreted as qualitative assessments of potential, longer-term effects of implementing habitat management plans for northern spotted owls, rather than as quantitative, statistical analyses of species' demographics and population trends. Likewise, our viability evaluations are not precise quantifications of extinction likelihoods. We fully expect that results of viability assessments for some species will change with availability of more precise data and quantitative models of populations or their environments.

Ecological Characteristics of Species - The following information was used in evaluating potential viability effects. Life history, ecological characteristics and legal listing status were compiled for each species on the short list.

In addition, range maps of the geographic distribution of each species on the short list of terrestrial vertebrates were obtained and entered into a Geographic Information System. The extent of each species' range within that of the northern spotted owl was superimposed onto

maps of reserved areas (such as congressionally designated Wilderness) and designated areas managed primarily for spotted owl habitat under each of the five planning alternatives in the Final Environmental Impact Statement. This analysis helped determine the general extent of the distributional range of each species on the short list that would be protected by (1) designated and reserved spotted owl habitat, and (2) forests outside of designated areas classified unsuitable for timber harvest.

Effects of Land and Resource Management Plans on Old-Growth Distribution Over Time - Also used in the evaluation was information on distribution and abundance of northern spotted owl habitat and old-growth forest cover under each of the five Final Environmental Impact Statement alternatives and as influenced by individual Land and Resource Management Plans from each National Forest. We used information from National Forests in Washington and Oregon on distribution of old growth as assessed with the previous inventory contracted with Pacific Meridian Resources (PMR). We also used the current land management allocations (full timber production, partial timber production, and no timber production allocations) from individual Land and Resource Management Plans from National Forests in Washington and Oregon as affecting the PMR old-growth categories (large old growth, small old growth, and other conifer) in each National Forest. Such data, along with maps of PMR old growth throughout the region and maps of each' National Forest's Land and Resource Management Plan, helped us discern the potential amount and arrangement of old-growth forest cover atpresent and over time that would be provided by individual forest plans in concert with that provided under each planning alternative presented in the Final Environmental Impact Statement.

Fish Experts' Evaluations - Viability of habitat for the anadromous salmonid stocks was evaluated by two members of the Scientific Analysis Team (Reeves and Sedell). Mitigation options for these stocks were developed in coordination with the Forest Service's Pacific Salmon Workgroup and Field Team (also known as "PacFish," USDA 1992a).

Expert Panel Evaluations - We convened a set of five expert panels to evaluate viability of the "short list" old-growth species. The panels evaluated risk of extirpation for each species by planning alternative from the Final Environmental Impact Statement. Each panel was made up of seven to eight recognized experts on (1) fungi, lichen, and nonvascular plants, (2) vascular plants, (3) amphibians and reptiles, (4) birds, and (5) mammals (Appendix 5-E).

In the course of their viability evaluations, the panels considered information on life history and ecological characteristics of each species (including information in Appendix 5-D), range maps of each vertebrate species, and the expected influence of each of the five planning alternatives on spotted owl habitat and old-growth forest cover over time. Each panel also considered each species in various portions of its range, and evaluated viability in each area separately, if the species was distributed in a disjunct (noncontiguous) pattern and would incur different risks viability in each area.

As a result of the panel deliberations, short lists used at the start of the assessment process were modified for nonvascular plants, vascular plants, amphibians, and mammals. Modifications reflected the panels' additions of species, or distinct populations in the species' ranges, to the lists. The viability ranking system used by the panelists is presented in Table 5-2. Hereafter, species considered throughout their range and species evaluated by the panels in a portion of their range will be referred to collectively as "species or ranges." (The numbers in these modified short lists are shown in Table 5-3.)

Table 5-2 Five-Class Viability Ranking Scale Used to Assess the Likelihood That Populations of Each Old-Growth Associated Species Would Stabilize or Increase Over Time. The Timeframe Considered Here is Approximately 50 Years (a Period Over Which we Assume that Most Old-Growth Forest Outside No-Yield Forest Allocations Would be Harvested).

HIGH - There is a high likelihood that the population(s) of the species would stabilize in National Forests within the range of the northern spotted owl. This provides broad latitude for natural catastrophes and uncertainties in knowledge. The likelihood of widespread or complete extirpation is low.

MEDIUM HIGH - There is a moderately high likelihood, somewhat better than 50/50, that the populations of the species would stabilize in National Forests within the range of the northern spotted owl. This provides limited latitude for natural catastrophes and uncertainties in knowledge. There is less than a 50/50 likelihood of widespread or complete extirpation.

MEDIUM - There is a roughly 50/50 likelihood that the population would stabilize, and a simflax likelihood of widespread or complete extirpation in National Forests within the range of the northern spotted owl. This provides extremely limited latitude for natural catastrophes and uncertainties in knowledge.

MEDIUM LOW - There is less than a 50/50 likelihood that the population would stabilize, and a greater than 50/50 likelihood of widespread or complete extirpation in National Forests within the range of the northern spotted owl. There is no latitude for natural catastrophes and uncertainties in knowledge.

LOW - It is highly unlikely that the species' populations would stabilize, and there is high likelihood of widespread or complete extirpation in National Forests within the range of the northern spotted owl. There is no latitude for natural catastrophes and uncertainties in knowledge.

Identification of Species With Viability at Risk - Three broad categories of species at risk of extirpation were defined by summarizing the viability rankings (shown in Table 5-2): low risk, medium risk, and high risk. We defined extirpation as the local extinction of a species from one or more National Forests within the range of the northern spotted owl, as a direct (but possibly delayed) effect of specific forest management activities. Thus, extirpation means the elimination of a species from a National Forest although it might continue to exist elsewhere. Exceptions to this may be local endemic species, such as stocks of anadromous salmonids, which are either entirely or largely restricted to areas managed by Forest Service.

For anadromous fish stocks, we used the risk of extinction ratings of Nehlsen et al. (1991). Stocks were identified as having a moderate or high risk of extinction or to be in need of special management considerations beyond those currently implemented in National Forest Land and Resource Management Plans. Criteria for these ratings were population size and trend.

Species with low risk of extirpation are those that were ranked by the panelists as "high" or "medium high" viability (Table 5-2) over an approximately 50-year period under at least one alternative. We felt that species in this category were likely to meet the population viability criteria presented in the regulations (36 CFR 219.19) implementing the National Forest Management Act; these species were not considered to be at risk.

Species with medium risk of extirpation are those that were generally ranked by the panelists as less than "medium high" viability (Table 5-2) over an approximately 50-year period under at least one alternative. We felt that such a risk category failed to meet the population viability criteria presented in the regulations implementing the National Forest Management Act.

A 50-year time period was chosen as representing a median duration over which adverse effects on viability as well as any significant modification of old-growth forest habitats, particularly timber harvesting, would occur.

Species with high risk of extirpation are those that were generally ranked by the panelists as less than "medium" viability (Table 5-2) over an approximately 50-year period under at least one alternative. High risk species are strictly a subset of the list of medium risk species above. High risk species are of even greater concern than are medium risk species because of their higher likelihood of extirpation within one or more planning area (National Forest) over the next years.

The panel of experts provided professional advice for use in our evaluation; the Scientific Analysis Team, however, made the final interpretations on viability. Overall, both levels of risks to viability were identified for all species groups except for invertebrates and fish stocks. Ecological associations and geographic distributions of invertebrates are very poorly known; therefore, viability of each invertebrate species could not be evaluated under each alternative at the present time.

Assessment of the probability of the proposed measures for maintaining and restoring habitat for anadromous salmonid fish stocks considered at risk (Nehlsen et al. 1991) was done for all 112 stocks as a unit rather than for individual stocks. Habitat degradation, which includes loss of or a decrease in the quality of freshwater habitat, has contributed to the decline of each stock (Nehlsen et al. 1991). Habitat requirements of the various species comprising the stocks vary considerably (Bjornn and Reiser 1991, Groot and Margolis 1991); however, and responses changes in habitat conditions resulting from land management activities may also vary (Reeves et al., in press). Although habitat requirements may vary, all species are dependent on the same suite of ecological processes and elements that structure and maintain habitat. We therefore assumed that the proposed mitigation actions were sufficiently robusto address the processes and elements that influence fish habitat and would result in the creation and maintenance of a range of conditions conducive to supporting all species and stocks collectively. Thus, we did not analyze each stock separately.

All aspects of the development of species lists were conducted in close coordination with the Northern Spotted Owl Recovery Team (USDI). Our assessments began with those conducted the Northern Spotted Owl Recovery Team, particularly by Anthony et al. (1992).

Viability Evaluation Methods- The following specific methods were used to evaluate viability of each species group.

a. Nonvascular Plants- An assessment of fungi, lichen, and nonvascular plants (bryophytes, including clubmosses, mosses, and liverworts) was led by Robin Lesher, a Forest Service botanist, under the guidance and oversight of the Scientific Analysis Team. (For purposes of clarity and brevity in this report, fungi, lichen, and bryophytes will be referred to collectively as nonvascular plants, although this is not strictly correct terminology.) Because much of the expert knowledge of these species resided with academic experts in the Pacific Northwest, contracting for and review by experts from outside the Forest Service was a major component of this assessment. These "outside" experts and

reviewers identified species closely associated with old-growth conditions and compiled known data on distribution and ecology of each species, Forest Service botanists also worked with the expert panel to evaluate potential risks to viability under each Final Environmental Impact Statement alternative and to identify mitigation options to help ensure high viability.

Collectively, fungi, lichen, and nonvascular plants were included in the assessment because they are vital elements of forest ecosystems. They play central roles in nutrient cycling and uptake by conifers and other tree species of commercial value, provide reservoirs of water, participate in decay and decomposition of organic matter and replenishment of soil fertility, and other ecological functions. Their ecological roles, distribution, abundance, and environmental relationships deserve greater study under ecosystem approaches to forest management.

As an example, some species of fungi (mychorrizae) are essential symbionts for assisting coniferous trees in nitrogen absorption. Their abundance, distribution, and sensitivity to changes in old-growth forest conditions directly influence forest health. Also, the ecology of dispersal agents for mychorrizae, such as northern flying squirrels, also play important roles in maintaining forest health. Lichens are used elsewhere as indicators of air quality. Likewise, many species of nonvascular plants are sensitive to changes in old-growth microclimates and habitat conditions and would likely serve as useful biological indicators of changes in forest ecosystem health.

b. Vascular Plants - Vascular plants were assessed with the help of a Forest Service core team of plant experts under the guidance and oversight of Joan Ziegltrum (a Forest Service ecologist) and the Scientific Analysis Team. Species lists and ecological characteristics of the species were compiled from existing literature, unpublished data from the Forest Service old-growth research program, ecology data bases from the Forest Service's Pacific Northwest and Pacific Southwest Regions, and information on threatened, endangered and sensitive plants from the Forest Service, Washington Natural Heritage Program, Oregon Natural Heritage Program, California Department of Fish and Game Natural Diversity Data Base, and California Native Plant Society (also see references cited in Appendix 5-B).

The core team of plant experts sought analysis and evaluation help from Forest Service botanists and ecologists, and from state and academic experts outside the Forest Service. The core team also worked with the expert panel on plants to evaluate potential risks to viability and to identify mitigation options.

c. Invertebrates - As a starting point in evaluating effects on invertebrates associated with old growth, we relied on earlier reports provided by the Northern Spotted Owl Recovery Team. The previous reports were authored by Frest and Johannes (1991) and Lattin and Moldenke (1992) and were used for the appendix on other species and ecosystems in the Draft Northern Spotted Owl Recovery Plan (see Anthony et al. 1992). These reports were reviewed under new contracts conducted for us as follows.

The report on mollusks by Frest and Johannes (1991) was reviewed by Ingrith Deyrup-Olsen, Professor Emeritus of Zoology at the University of Washington, Seattle, and an expert in the field (see Appendix 5-E for all reviewers' affiliations). The review

focused on evaluating the content and conclusions of the previous report (letter to Scientific Analysis Team from Deyrup-Olsen dated November 6, 1992).
The report on arthropods by Lattin and Moldenke (1992) was reviewed under contract with The Xerces Society in Portland, Oregon, a society established for the study and conservation of invertebrates. The contract resulted in a second report, authored by David M. Olson (1992), Division of Environmental Studies, University of California, Davis. Olson reviewed the content and conclusions of the previous work and included a qualitative evaluation of how the five Final Environmental Impact Statement alternatives collectively might affect arthropods.

Because of a lack of information, invertebrates were not evaluated for viability under each of the planning alternatives. However, the contract reports consistently underscored the following themes: (1) invertebrates are little studied and little understood in the Pacific Northwest; (2) many species play crucial and diverse ecological roles in late-successional forest ecosystems, including decomposers of organic material for replenishment of soils, pollinators of flowering plants, and prey for a wide variety of other invertebrates and vertebrates; and (3) many arthropods can serve as biological indicators of forest health (Lattin and Moldenke 1992, Asquith et al. 1990, Olson 1992).

d. Fish - Evaluation of the effects of the various alternatives on habitat of at-risk stocks of anadromous salmonids in National Forests within the range of the northern spotted owl was derived from ongoing evaluations of anadromous fish (USDA 1992a). The assessment for these stocks was based on habitat conditions and not populations. Refer to Appendix 5-K for justification for assessing the effects on habitat.

Each alternative in the Final Environmental Impact Statement was evaluated in terms of: (1) the probability of maintaining or restoring riparian zones and their ecological functions and processes; (2) presence and components of a watershed restoration program; and (3) the fraction of the landscape covered by spotted owl reserves, particularly that contained within key watersheds (Johnson et al. 1991). All Final Environmental Impact Statement alternatives lacked riparian management standards and a watershed restoration component. Therefore, we assumed that riparian zone management standards and guidelines for Land and Resource Management Plans would apply. Emphasis was on the fraction of key watersheds contained within spotted owl reserves.

Key watersheds had previously been identified as part of an evaluation of alternatives for the management of late-successional forests by Johnson et al. (1991). These were watersheds that either currently contained good quality habitat or were in poor condition but had a strong potential to be restored. These were identified with the assistance of fish biologists from National Forests within the range of the northern spotted owl. Key watersheds identified in Johnson et al. (1991) in California were modified slightly after evaluation by the Forest Service's Pacific Southwest Region Fish and Watershed Work Group, which did so as part of an assignment to develop a strategy for managing fish habitat and riparian ecosystems for the Six Rivers, Mendocino, Klamath, and Shasta-Trinity National Forests. Some watersheds originally identified were removed and others added. Key watersheds in California that were evaluated in this exercise included these changes.

e. Terrestrial Vertebrates - We evaluated amphibians, reptiles, birds, and mammals by review of selected literature on species' orientations to late-successional and old-growth forests to identify long and short lists. We also worked with the expert panels on amphibians and reptiles, birds, and mammals to evaluate potential viability concerns under each Final Environmental Impact Statement alternative and mitigation options to help ensure high viability.

We also sought technical advice on viability of, and mitigation options for, marbled murrelets from several experts on the species including Eric Cummins and Thomas Hamer (Washington Department of Wildlife), Kim Nelson (Oregon Cooperative Wildlife Research Unit, Oregon State University), and C. john Ralph (Pacific Southwest Forest and Range Experiment Station, Forest Service).

Identification of Unknowns and Species of Undetermined Status - For each species group above, we also identified the species for which scientific information is inadequate or lacking by which to judge viability effects and mitigation options needed to help ensure high viability over time.

Identification of Mitigation Options

The expert panels helped to identify mitigation options for habitat conditions conducive to providing for high viability, for all medium-risk species (that is, those species that ranked less than "medium high" in viability). Mitigation options included general quaiitativ_eand, where available, quantitative management standards that would provide needed habitat conditions, such as provision of components of old-growth forests outside Habitat Conservation Areas for northern spotted owls.

In identifying mitigation options (standards and guidelines for management of vital habitat components), we relied on the advice of the expert panels on plants and terrestrial vertebrates, the content of the contract reports on invertebrates, results of the Pacific Salmon Workgroup, and additional supplementary information on fish, northern goshawks, marbled murrelets, American marten, lynx, and other species.

To combine mitigation options among all medium-risk species under Alternative B, we used the following incremental process (hereafter referred to as steps, although they should be applied as a collective set and not necessarily in a step-wise fashion). In each step, the habitat needs of additional old-growth species were provided in a cumulative fashion. To ensure the needs of all species, the mitigation guidelines resulting from all steps would need to be adopted.

The general procedure we used to develop the mitigation steps follows. We first identified old growth protected by existing National Forest Land and Resource Management Plans. Next, we included the Interagency Scientific Committee's Conservation Strategy for the northern spotted owl in National Forests, as analyzed in the Final Environmental Impact Statement. One variant of the Interagency Scientific Committee's Conservation Strategy that we included here as an optional mitigation step is the modification to Habitat Conservation Areas as presented in Chapter 3 of this report. Next, we considered the additional needs for species with existing or impending Federal threatened or endangered species status; these were also additional old-growth species with the broadest scope of habitat requirements or distributional ranges, and with current viability concerns. These species included anadromous at-risk fish stocks and marbled murrelet. We then added other old-growth species of more local concern and with narrower ecological or

distributional ranges. Finally, we added any additional species that occur in the upland forest matrix that were not already included in the above lists. The overall result of implementing the mitigation activities identified in all steps combined is likely to be security from extirpation for all species of late-successional and old-growth forests in National Forests within the range of the northern spotted owl, for which scientific information was adequate. However, the degree of security from extirpation risk for species on which there was inadequate information is still unknown and cannot be judged.

Mitigation Step 1 - Standards and Guidelines From Existing Land and Resource Management Plans of National Forests Within the Range of the Northern Spotted Owl. This step entailed simply accepting the standards and guidelines in existing National Forest Land and Resource Management Plans. The viability needs of some of the "short list" species closely associated with old-growth forests or old-growth forest conditions would be provided by these standards and guidelines for forest management. This step entailed identifying which species would and would not be provided for under existing standards. We assumed for this assessment that existing management direction corresponded to Final Environmental Impact Statement Alternative A.

Mitigation Step 2a - Standards and Guidelines for Habitat Conservation. Areas Under Alternative B. We identified the standards and guidelines for habitat management under Alternative B (the Interagency Scientific Committee's Conservation Strategy) in the Final Environmental Impact Statement. This established the extent and locations of Habitat Conservation Areas and management guidelines for provision of dispersal habitat in the forest matrix between Habitat Conservation Areas, according to guidelines from the Interagency Scientific Committee's Conservation Strategy. In this step, we identified the species that would and would not be provided for by the combination of the standards and guidelines from National Forest Land and Resource Management Plans and from Alternative B of the Final Environmental Impact Statement.

Mitigation Step 2b - Recommended Additions to Habitat Conservation Areas in National Forests We identified additions to Habitat Conservation Areas within National Forests that may be needed as mitigation options for reduced spotted owl viability associated with preferred alternatives of Bureau of Land Management's Draft Resource Management Plans (see Chapter 3).

Mitigation Step 3 - Standards and Guidelines for Riparian Habitat Conservation Areas We then applied standards and guidelines designed for protecting habitat for the 112 fish stocks at risk. This step provided a substantial increase in the distribution and extent of existing and potential old-growth forest cover for a wide variety of species. We listed the resident fish and non-fish species likely to be also benefited by mitigation options for anadromous fish and riparian habitat.

Mitigation Step 4 - Standards and Guidelines for Marbled Murrelet We developed standards and guidelines for protecting nesting habitat for the marbled murrelet. This accounted for additional forest areas conserved within proximity to marine environments. We then identified other species likely benefited by the combination of guidelines for the Riparian Habitat Conservation Areas and for protection of nesting habitat for the marbled murrelet.

Mitigation Step 5 - Standards and Guidelines for Rare and Locally Endemic Species
We then identified rare and locally endemic species requiring inventory for locating specific occurrences, for the purpose of conserving habitat conditions at those individual sites.

Mitigation Step 6 - Additional Standards and Guidelines for Other Species in the Upland Forest Matrix. Finally, we identified any other species not included in the first five steps that would require additional standards and guidelines for conserving old-growth forests and components of old-growth forests in the upland forest matrix outside of conservation areas described in Mitigation Steps 1 through 5.

We did not quantitatively analyze the demography, population size and trend, genetics, or disturbance dynamics of populations and their environments, Rather, we addressed only the components of habitats directly or indirectly affected by management activities in National Forests. Managing such components is a necessary, but not always sufficient, set of conditions to ensure viability of each species throughout its range, even only in National Forests. For example, restoring viability to many fish stocks at risk would also entail addressing problems outside National Forests, including effects of hydroelectric structures, harvesting, and hatchery practices. Likewise, changes in regional climate and air quality would likely affect the distribution of species of lichen and other nonvascular plants in inland valley environments outside National Forests, thereby increasing, over time, the species' reliance on old-growth forest habitats in National Forests over time. These are significant factors to consider in a viability assessment. As new information becomes available, a reevaluation of our recommendations may well be warranted if future viability analyses incorporate these factors.

Also, management of late-successional forests and northern spotted owl habitat on other lands, such as those administered by the Bureau of Land Management in southwest Oregon, can influence the distribution and abundance of many old-growth wildlife species in National Forests. Overall, we did not quantify such potential off-site effects, but we did consider their qualitative influences on National Forest biota and accounted for them in many of our evaluations.

We also addressed the habitat requirements of some species whose geographic range overlaps that of the northern spotted owl only along fringes of their ranges. Some of these specie s were rated as having medium to high risk to viability. However, management of their habitats outside the range of the northern spotted owl would have a major influence on maintaining their long-term viability. This report does not address those additional needs because our charge was to identify extirpation risks and mitigation options for helping to ensure viability of species and habitats within the northern spotted owl's range.

We also identified mitigation options in coordination with Forest Service Pacific Northwest and Pacific Southwest Regions, drawing on management standards and guidelines in preparation but not yet in effect. This was particularly useful for identifying habitat needs of marbled murrelets, northern goshawks, and American martens, and for coordinating with ongoing management efforts to provide these needs.

RESULTS

Identification of Old-Growth Species

We evaluated over a thousand plant and animal species for their association with old-growth forests of the Pacific Northwest within the range of the northern spotted owl (this was the "long list" of species; see Appendix 5-A for long list of terrestrial vertebrates). These species included nearly 700 species of plants and fungi, 214 stocks of at-risk anadromous salmonids, 4 species of resident fish, and 224 terrestrial (non-fish) vertebrates (Figure 5-1). In addition, our contractors considered hundreds of invertebrate species. Of these totals, 312 plants, 149 invertebrates, 112 stocks of anadromous salmonids, 4 species of resident fish, and 90 terrestrial vertebrates were found to be closely associated with old-growth forest conditions ("short list" species). We had concerns for viability under each alternative in the Final Environmental Impact Statement for a smaller subset of species, as described below. We also had concerns about the viability of all 112 fish stocks identified for our project by our fish habitat experts, and all 149 species of invertebrates identified by our contractors and in the previous assessments.

Assessments by Species Groups

Nonvascular Plants - A total of 42 species of fungi (mostly mushrooms) and 148 species lichens and nonvascular plants (liverworts and mosses) were evaluated for viability status under each of the five alternatives in the Final Environmental Impact Statement (Appendix 5-It). Little is known about many of the fungi, lichen, and nonvascular plants. Scientific, ecological information was lacking for 39 species. As a result, viability could only be rated with great uncertainty, if at all (Appendix 5-J). However, viability assessments could be made for many other species for which more information was available. The number of species assigned medium risk to viability ranged from 19 under Alternative D to 147 under Alternative E. The number of species with a high risk to viability ranged from 4 under Alternatives B, C, and D, to 82 under Alternative E.

Under Alternative B - the selected alternative in the Final Environmental Impact Statement (the Interagency Scientific Committee's Conservation Strategy) - 38 species or ranges were at medium risk (Appendix 5-H). The 38 species or ranges included 18 fungi, 2 lichens, 6 liverworts, and mosses. The 4 species with high risk to viability under Alternative B included 1 species of fungus and 3 mosses.

Vascular Plants - A total of 122 species or ranges of vascular plants were evaluated for viability effects (Appendix 5-H). Vascular plants include a wide variety of life forms, some of which are economically important to the Pacific Northwest. Species of vascular plants assessed in this report included saprophytes (plants that live off of decaying vegetable matter), root parasites, orchids, grape ferns, heaths, shrub heaths, coniferous trees, ferns, grasses, and other herbaceous forms. As with all other species groups evaluated in this report, some of the vascular plant species have quite narrow geographic distributions ("local endemics") or occur only in very specific conditions of forest structure and soil (such as the serpentine barren species of Klamath Mountains in southwestern Oregon and northwestern California).

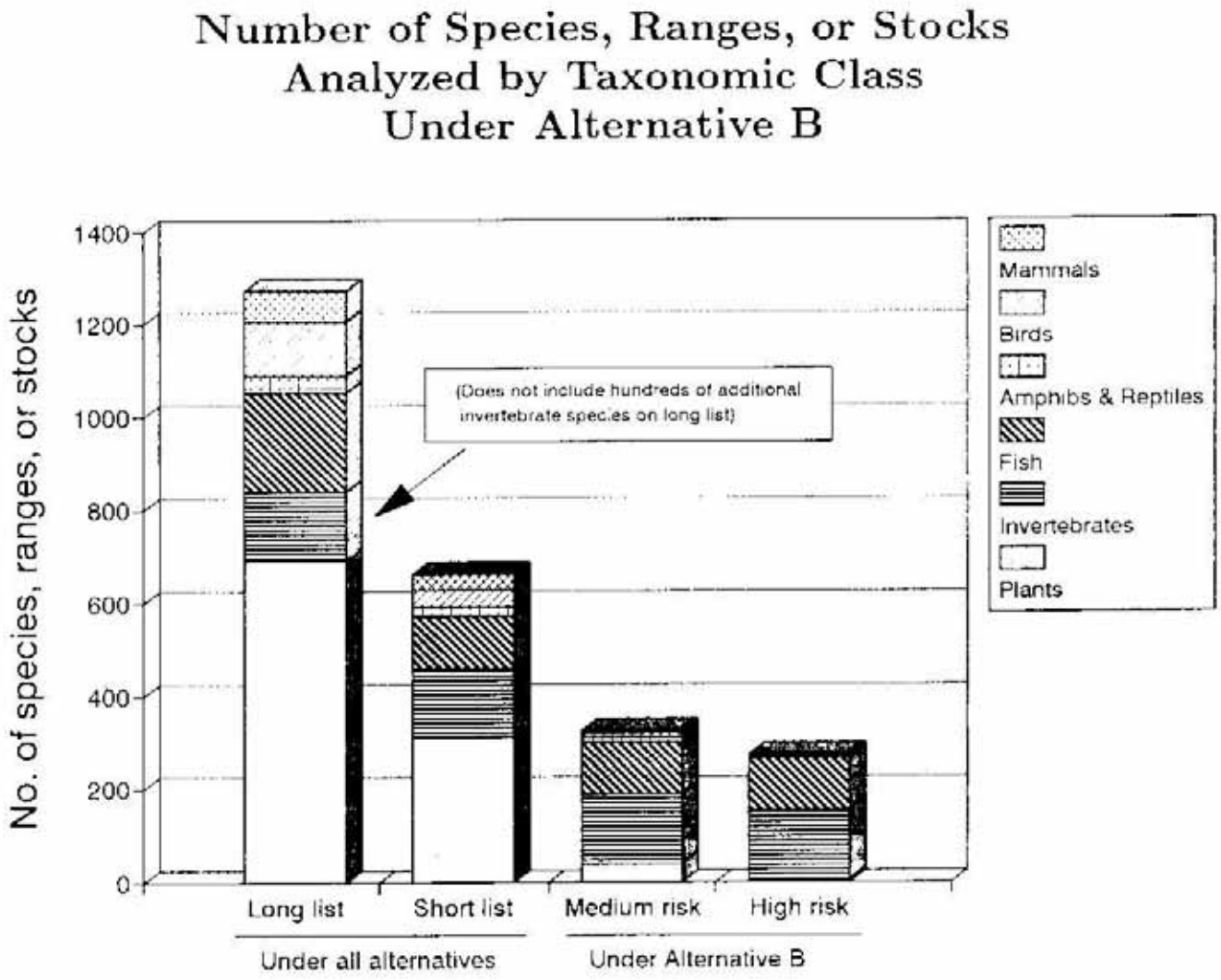

Figure 5-1 Number of Species, Ranges, or Stocks Analyzed by Taxonomic Class Under Alternative B of the Final Environmental Impact Statement.

Under each of the five alternatives described in the Final Environmental Impact Statement, the number of species or ranges with medium risk to viability ranged from none under Alternative B to 5 under Alternative E. One species, Pacific yew, is at high risk, but only under Alternative E. Sufficient scientific information to justify rating viability by alternative was lacking for 10 species.

Under Alternative B, none of the vascular plant species was determined to have either medium or high risk. However, two vascular plants (both are orchids) were rated as being at medium risk viability under Alternatives C and D. This is because the species require ground fire disturbance that the panel on vascular plants felt might be more rare and less extensive under Alternatives C and D than under Alternative B.

Invertebrates - A total of 149 species of invertebrates, including 58 mollusks and 91 arthropods (Appendix 5-F), were identified as closely associated with old-growth forests or old-growth forest conditions. Out of a regional list of more than 7,000 species (Olson 1992), we could find reliable data on distribution for only a few hundred species closely associated with old growth.

Olson (1992) concluded that none of the proposals for spotted owl conservation areas on Federal lands would be adequate to capture the full invertebrate diversity that currently exists across the landscape. In particular, in the coming century, if the only remaining tracts of old-growth forest are located within the Habitat Conservation Areas and Critical Habitat Areas designated in Alternatives B and C in the Final Environmental Impact Statement, "then there is a very high probability that many invertebrate species extinctions will occur in areas not covered by protected lands, particularly in the coastal forests of Oregon and northern California, the Klamath Province, and the Olympic Peninsula that are known for a high degree of [species] diversity" (Olson 1992:9-10). Although Olson may have underestimated the extensive coverage of Habitat Conservation Areas under Alternatives B and C in the Oregon Coast Range and Olympic Peninsula Provinces, local distributions of some invertebrate species might still range outside the Habitat Conservation Areas. Populations of the less vagile species remaining within Habitat Conservation Areas would likely become isolated into smaller populations unless connected with corridors of forest cover, as might be provided by some of the mitigation options discussed below.

We identified 79 invertebrate species as closely associated with both old-growth forests and riparian habitats (see Appendix 5-F). Many of these species would likely benefit from increased riparian habitat protection, as discussed below under Mitigation Step 3.

Fish - We evaluated 112 stocks of anadromous salmonids representing 7 species found in National Forests (Appendix 5-C). Numbers of stocks of fish are based on current knowledge, and are likely to change. These stocks have been identified by Nehlsen et al. (1991) as being risk of extirpation. Additionally, we considered 4 other fish species recognized by Williams et al. (1989) as being in various stages of population decline (Appendix 5-C). These 4 species included bull trout which are currently being considered by the Fish and Wildlife Service for threatened status. Like the anadromous salmonids, habitat loss and degradation have also contributed to the decline of these 4 species. Habitat loss and degradation are responsible, at least in part, for the decline in habitat and populations of each stock.

None of the five alternatives described in the Final Environmental Impact Statement provided a high probability of maintaining or restoring fish habitat for the 112 anadromous salmonid stocks (Appendix 5-G). The Final Environmental Impact Statement alternatives did not specify any

riparian management zone standards; nor were Habitat Conservation Areas delineated based

on riparian zones or watersheds. Standards and guidelines for protecting riparian management areas vary substantially in quality among National Forests. Most plans lack goals that establish a "vision" for management and use of anadromous fish resources. Few plans include objectives for anadromous fish management that are: time-specific, measurable, comprehensive, and established on a drainage or other biologically significant basis. In general, planning documents fail to address indirect and/or cumulative effects, or they address them only in a cursory manner. Rarely do plans provide documentation of a formal, standardized cumulative effects process that was applied on a drainage specific basis. Few plans specifically consider anadromous fish needs in delineating management areas. Overall, such standards and guidelines were rated as fair because of the relatively small width of forest buffers protected from cutting along fish bearing streams, generally <200 feet, the absence or small size of riparian management areas along intermittent streams, and the amount of activity allowed within riparian management areas.

Additionally, among the five alternatives evaluated in the Final Environmental Impact Statement, a relatively small fraction (generally <25 percent) of the key watersheds were contained within designated areas managed primarily for northern spotted owl habitat, although this fraction varied by Final Environmental Impact Statement alternative and physiographic province. This coincides with the Draft Recovery Plan for the Northern Spotted Owl (USDI 1992a) estimate that <20 percent of the approximately 12,000 miles of streams with fish stocks considered at risk were within their Designated Conservation Areas. We estimated that more than 50 percent of the area of key watersheds in National Forests overlapped the designated areas managed primarily for spotted owl habitat (i.e., Habitat Conservation Areas; all remaining nesting, roosting, and foraging habitat)under Alternative D. However, Alternative D rated only a medium probability of maintaining and restoring fish habitat because of the riparian management standards and guidelines and the absence of a watershed restoration program in the National Forests. Other alternatives in the Final Environmental Impact Statement rated lower than Alternative D because of the lower percentage of coincidence of key watersheds and other streams inside areas protected from timber harvest.

Amphibians - A total of 21 species or ranges of amphibians were evaluated for viability effects. Some of the salamander species are locally endemic within small geographic ranges in the Pacific Northwest. The number of amphibian species or ranges judged to be at medium risk to viability ranged from 8 under Alternative D to 20 under Alternatives A and E. Of these, the number judged to be at high risk ranged from 6 under Alternative D to 18 under Alternative E. Scientific information was judged sufficient to assess viability effects of all amphibian species.

Under Alternative B, 11 species or ranges (including 10 salamanders and the tailed frog) were determined to be at medium risk and 7 at high risk. Van Dyke's salamander was considered in two parts of its overall range, and was rated as being at high risk of extirpation in both parts, under Alternative B. Most of the 11 at-risk species or ranges have narrow geographic distributions and occur in localized riparian, headwater, or talus (loose rock) habitats.

Reptiles - A total of 10 species of reptiles (turtles, lizards, and snakes) were initially evaluated in the "long list" for their association with old growth (Appendix 5-A). None of these species was considered to be closely associated with old-growth forest conditions (Appendix 5-A). Thus, no further viability assessments were conducted on reptiles. However, some reptile species, such as the sharp-tailed snake and northern alligator lizard, are associated with components of old-growth forests, including large down logs and forest litter cover. Such species would be secondarily benefited by provision of such forest elements under any of the planning alternatives

and provision for riparian habitat protection.

Birds - A total of 38 species or ranges of birds were evaluated for viability effects. The birds included various species of owls and other birds of prey, marbled murrelet, song birds, and others.

Under each of the five alternatives described in the Final Environmental impact Statement, the number of species determined to be at medium risk to viability ranged from 6 under Alternative D to 17 under Alternatives A and E. Of these, the number of species determined to be at high risk ranged from 1 under Alternatives B, C, and D, to 6 under Alternative E. Information was sufficient to allow us to assess viability for all bird species.

Under Alternative B of the Final Environmental Impact Statement, 9 species were rated as being at medium risk and 1 of these species, marbled murrelet, at high risk. The species at medium risk included several species at the edge of their ranges (such as black-backed woodpecker and pygmy nuthatch) or that use riparian and aquatic habitats (such as bufflehead and harlequin duck). Other birds at medium risk that were distributed more broadly within the range of the northern spotted owl and more associated with spotted owl habitat included the northern goshawk, flammulated owl, and great gray owl.

Mammals - A total of 35 species or ranges of mammals were evaluated for their viability. These species included furbearers (including fisher, American marten, lynx, and others), bats, rodents, and other species groups.

Under each of the five alternatives described in the Final Environmental Impact Statement, the number of species or ranges judged to have medium risk to their viability ranged from 6 under Alternative D to 12 under Alternatives A and E. Of these, the number of species or ranges judged to be at high risk ranged from 1 under Alternative D, to 9 under Alternative E. Information was inadequate for ranking viability for 10 other species.

Under Alternative B of the Final Environmental Impact Statement, 8 species or ranges were rated as being at medium risk to viability and 5 of these as being at high risk. The American marten was ranked as being at medium risk in one portion of its range and at high risk in two other portions. The fisher was determined to be at medium risk in one portion of its range and at high risk in another portion. Both species of red tree vole (prey species of the northern spotted owl) rated as being at high risk. The ranges of the lynx and the northern spotted owl are both extensive but only overlap along a narrow fringe area. The lynx was rated as being at medium risk. Most of the bats could not be rated because of lack of information.

Summary of Species at Medium and High Risk - Appendix 5-H presents an overall list of species of all taxonomic classes judged to be at medium or high risk to viability under at least one of the five alternatives described in the Final Environmental Impact Statement. The number of species or ranges (excluding invertebrates and fish) determined to have medium risk to their viability totaled as low as 41 under Alternative D in the Final Environmental Impact Statement and as high as 201 under Alternative E in the Final Environmental impact Statement. Alternative E in the Final Environmental Impact Statement had the greatest number of species or ranges estimated to have medium risk, in part because it does not provide for old growth in Habitat Conservation Areas for the spotted owl in the Olympic Peninsula or in the northern Oregon Coast Range. Alternative E also provides for substantially less amounts of old growth protected in other locations in the Pacific Northwest. Alternative A in the Final Environmental Impact Statement also had high numbers of species or ranges determined to have

risks to viability because its reserves for spotted owls (Spotted Owl Habitat Areas) provided for

substantially smaller old-forest conservation areas than do Alternatives B, C, and D in the Final Environmental Impact Statement. Alternatives B, C, and D in the Final Environmental Impact Statement progressively provide for greater numbers of species or ranges. Under Alternative B in the Final Environmental Impact Statement, 67 total species or ranges (excluding invertebrates and fish) were ranked medium risk and 17 of these were ranked high risk. With inclusion of invertebrates and fish, these tallies were 328 and 278, respectively.

The 32 Old-Growth Species Listed in the Final Environmental Impact Statement

Thirty-two species associated with late-successional forests were listed in the Final Environmental Impact Statement. All 32 were included in the short list of species closely associated with old growth. Under Alternative B of the Final Environmental Impact Statement, 25 of the 32 species were not considered to be at risk in terms of viability. Three species are at medium risk to viability, and 3species were Considered at high risk. In addition, the Scientific Analysis Team considered one species from the list of 32 species - the Olympic Salamander" as a (newly defined) complex of four species,¯ one of which was deemed to be at medium risk and three of which were deemed to be at high risk. Another species - red tree vole - is considered here as a (newly defined) complex of two species, both of which were deemed to be at high risk extirpation. And one species, fisher, was considered to beat medium risk in one portion of its range and at high risk in the other (Appendix 5-I).

Mitigation Options for Species With Medium or High Risk to Viability Under Alternative B

Mitigation options were considered for the set of 328 species or ranges (38 fungi and nonvascular plants, 0 vascular plants, 58 mollusks, 91 arthropods, 112 fish stocks, 12 amphibians, 0 reptiles, 9 birds, and 8 mammals; see Table 5-3) considered to be at medium or high risk to viability under Alternative B of the Final Environmental Impact Statement (also see below for lists of species accommodated under each step in the mitigation process). Mitigation options developed for the 112 stocks of anadromous salmonids also provide protection to viability for the 4 additional species of resident fish.

We assumed that habitat conditions for species closely associated with old growth would be maintained under the following mitigation options. If the protected areas called for are manipulated in a way that diminishes old-growth habitat conditions, our assumption would no longer be valid.

The step-down mitigation procedure resulted in identifying the following sets of species requiring management standards and guidelines beyond those in Alternative B as described in the Final Environmental Impact Statement. These steps are cumulative in effect. Each set of species considered in a step assumes implementation of mitigation activities in all previous steps.

Mitigation Step 1 – <u>Standards and. Guidelines From Existing Land and Resource Management Plans of National Forests Within the Range of the Northern Spotted Owl</u>. Standards and guidelines influencing the management of old-growth forests and components of :old-growth forests are described in the individual Land and Resource Management Plans for National Forests within the range of the northern spotted owl They are not repeated here. Species associated with old-growth forests or old-growth forest components within

the range of the northern spotted owl that would be provided for by application of the Land and Resource Management Plan standards and guidelines include all of the "short list" old-growth associated species that were not identified as being either at medium or high risk under Alternative A (current management direction). (Complete lists of species evaluated are available from the authors upon request.)

Mitigation Step 2a - Standards and Guidelines for Habitat Management Under Alternative B. This step entailed reviewing the standards and guidelines for management of habitat for northern spotted owls under the selected alternative (Alternative B) the Final Environmental Impact Statement. Habitat needs for the northern spotted owl are provided by this alternative, assuming that the Interagency Scientific Committee's guidelines are followed on all Federal lands. In addition, other old-growth species provided for by application of Alternative B of the Final Environmental Impact Statement that are not included in the first mitigation step above, are those species that were identified as being either at medium or high risk under Alternative A (current condition) but not under Alternative B. Implementation of Alternative B would reduce the number of species with risk of extirpation by 120 species (Table 5-3).

Mitigation Step 2b - Recommended Additions to Habitat Conservation Areas in National Forests This optional step entailed reviewing the additions to the Habitat Conservation Areas in National Forests if necessary under the assumption that USDI Bureau of Land Management would not follow the Interagency Scientific Committee's Strategy (Chapter 3). Without adjustment of Habitat Conservation Areas in National Forests, viability of the northern spotted owl is rated as low under their current plans (the "Bureau of Land Management/Oregon Department of Fish and Wildlife Agreement Areas"), and medium under preferred alternatives in the Bureau of Land Management's Draft Resource Management Plans. With the addition of approximately 418,000 acres to Habitat Conservation Areas in National Forests, the spotted owl's viability would be rated as high (Chapter 3). The addition to Habitat Conservation Areas of 418,000 acres would contribute to maintaining the viability of a number of additional species. However, these additional acres were not designed to provide mitigation for species other than the spotted owl. In addition, the designation of these acres was only one of several outcomes, depending on the plan actually adopted by the Bureau of Land Management. For this reason, we did not tie the viability assessment of any other species to this acreage.

Table 5-3 Number of Species or Ranges and Fish Stocks Identified as Potential Viability Concerns That are Protected by the Cumulative Mitigation Steps Discussed in the Text.

Mitigation Step:	1. National Forest planning standards and guidelines	2a. or 2b.[1] Alternative B FEIS[2] standards and guidelines	3. Species benefited by Riparian Habitat Conservation Areas	4. Species benefited by marbled murrelet protection	5. Mitigation for rare and locally endemic species	6. Additional mitigation for upland forest matrix species	TOTAL (All 6 mitigation steps)	Unknowns: Unknown but likely protected by mitigation measures	Unknowns: Degree of protection generally unknown
Species groups									
Nonvascular Plants (198)[5]	18	95	5	19	14	0	151	20	19
Vascular Plants (122)	108	4	0	0	0	0	112	2	8
Invertebrates (149)		(Not rated by alternative)						0	149
Fish[3] (112)	0	0	112	0	0	0	112	0	0
Amphibians (21)	1	8	7	1	3	1	21	0	0
Reptiles[4] (0)	0	0	0	0	0	0	0	0	0
Birds (38)	20	9	2	2	0	5	38	0	0
Mammals (35)	13	4	5	2	0	1	25	1	9
TOTAL (667)	160	120	131	24	17	7	459	23	185
Cumulative Guidelines that apply	1	1-2	1-3	1-4	1-5	1-6	1-6	1-6	1-6
Cumulative spp. totals	160	280	411	435	452	459	459	482	667

[1]This column reflects either the original standards and guidelines in Alternative B of the Final Environmental Impact Statement or those standards and guideline supplemented by mitigations for actions on lands administered by the Bureau of Land Management (see Chapter 3).
[2]FEIS = Final Environmental Impact Statement.
[3]Mitigations developed for 112 stocks of anadromous salmonids also provide for 4 additional species of resident fish.
[4]No reptile species was identified on the short list of species closely associated with old-growth forests, and thus none was identified as extirpation risk.
[5]Values in parentheses axe the total number of species or ranges and fish stocks identified by each expert panel as closely associated with old-growth forests or conditions ("short list" species) in National Forests within the range of the northern spotted owl.

Mitigation Step 3 - Standards and Guidelines for Riparian Habitat Conservation Areas

a. Riparian Habitat Conservation Area Designation

The size and management of Riparian Habitat Conservation Areas vary depending on stream type and aquatic ecosystem type as outlined in Table 5-4. Riparian Habitat Conservation Area widths for streams are horizontal distances and are measured on each side from the edge of the active stream channel. Active channels consist of all portions of the stream channel carrying water at bankfull flows. They include side-channels and backwaters, which may not carry water during seasonal low flows. Riparian Habitat Conservation Area dimensions for lakes, ponds, springs, seeps, meadows, and small wetlands are measured from the outer edge of the seasonally saturated soils. In the case of reservoirs, distances are measured from the maximum pool elevation. See Appendix 5-K for further criteria on establishing Riparian Habitat Conservation Area dimensions.

Table 5-4 lists interim minimum Riparian Habitat Conservation Area widths that will be in place until a watershed analysis is completed (as explained in Appendix 5-K). In general, watershed analysis consists of a systematic examination of Riparian Habitat Conservation Areas to characterize watershed history, processes, and landforms and conditions. Boundaries of Riparian Habitat Conservation Areas may be altered after completion of the watershed analysis if warranted by the information resulting from that analysis. The result is the identification of parts of the landscape that influence the creation and maintenance of habitat for fish and other riparian species. Particular attention should be given to terrestrial or semi-aquatic organisms (e.g., molluscs, amphibians) that are associated with the microclimates of non-fish bearing and intermittent streams. Habitat associations of many of these organisms are not completely understood at this time.

Table 5-4 Interim Boundaries of Riparian Habitat Conservation Areas (RHCAs) Delineated Along Different Water Bodies and Area of the Watershed.

Water Bodies	Interim Boundaries of RHCAs
Fish bearing streams	edge of active channel to: - top of inner gorge, or -outer edges of 100-year floodplain, or - outer edges of riparian vegetation , or - a distance equal to height of two site potential trees on each side of stream, or - 300 feet horizontal distance on each side of stream, whichever is greatest
Perennial, non-fish: bearing streams	edge of active channel to - top of inner gorge, or - outer edges of 100-year floodplain, or - outer edges of riparian vegetation, or - a distance equal to height of one site potential tree on each side of stream, or - 150 feet horizontal distance on each side of stream, whichever is greatest
Ponds, reservoirs, and wetlands >1 acre	edge of water body to: - outer edge of riparian vegetation, or - extent of seasonally saturated soil, or - extent of moderately or highly unstable areas, or - a distance equal to height of one site potential tree, or - 150 feet horizontal distance for ponds and wetlands >1 acre, - 150 feet from edge of maximum pool elevation of reservoirs ; whichever is greatest
Lakes	edge of water body to: - outer edge of riparian vegetation, or - extent of seasonally saturated soil, or - extent of moderately or highly unstable areas, or - a distance equal to height of two site potential trees, or - 300 feet horizontal distance, whichever is greatest
Seasonally flowing or intermittent streams, wetlands <1 acre, landslides and landslide prone areas	edge of stream channel or wetland to: - top of inner gorge, or - outer edges of riparian vegetation, or - extent of landslides and landslide-prone area5, or - a distance equal to height of one site potential tree on each side of stream, or - 100 feet horizontal distance on each side of stream, whichever is greatest

Within the Riparian Habitat Conservation Areas, timber management and other land management activities are essentially prohibited unless the watershed analysis indicates such activity is necessary to accelerate meeting desired ecological conditions. Specific standards and guidelines (Appendix 5-K) were developed to guide land management activities within Riparian Habitat Conservation Areas.

b. Other Species Benefited by Riparian Habitat Conservation Areas

The following species whose viability is considered to be at risk under Alternative B are likely to have their viability assured after application of the mitigation options for riparian habitat protection,

(1) Nonvascular plants:

(a) *Usnea longissima* (Lichen) This species is found in both hardwoods and softwoods in riparian fog belts. This species requires forests on broad riparian areas and should be maintained by protecting riparian habitats, especially by controlling upstream timber harvesting. These needs are likely met by the Riparian Habitat Conservation Area guidelines.

(b) *Metzgeria conjugata* (Liverwort) This species occurs in fog areas of coastal forests especially along streams. Its needs are likely met by the Riparian Habitat Conservation Area guidelines.

(c) *Dicranella palustra* (Moss) This species occurs in 1st-order streams coniferous forest and is sensitive to siltation. This species is endemic to the west coast and needs riparian forests. Mitigation options include protection of stream buffers of at least 100 feet width on each side of the stream, protection of non-anadromous streams, and upstream protection from logging and road building. Mitigation options also include preventing 1st-order streams from siltation and piling of logging debris, and maintaining a component of coarse woody debris for substrate needs. All of these mitigation activities are included in the Riparian Habitat Conservation Area guidelines.

(d) *Hygrohypnum bestii* (Moss) This species is included in the species group with *Dicranella palustva*, above, with the same conditions and mitigation options.

(e) *Mythicomyces corneipes* (Fungus) This mushroom occurs in low elevation moist humus soils with mosses and old-growth conifer stands throughout the range of the northern spotted owl from sea level to 4,000 feet elevation. Mitigation measures include maintaining moist conifer forest habitats. These needs are likely met by the Riparian Habitat Conservation Area guidelines.

(2) Amphibians:

(a) Van Dyke's Salamander (Coastal, Olympic Peninsula, and Cascades populations) - This species is associated primarily with seeps and streamside talus, although it also occurs in association with moist soil on shaded north-facing slopes. Van Dyke's salamander is very rare and occurs in

small, isolated populations. Seeps and headwater streams are key habitats throughout the species' range. The combination of National Forest Land and Resource Management Plans, Alternative B of the Final Environmental Impact Statement, and Riparian Habitat Conservation Area guidelines, particularly buffered habitats along headwater streams, will provide needed protection for this species. We foresee no critical needs for further protection.

(b) Olympic Salamander complex –

Olympic torrent salamander (Rhyacotriton olympicus) Olympic Peninsula
Columbia torrent salamander (R. *kezeri*) - Coastal Oregon (northern)and Washington (southern)
Cascade torrent salamander (R. *cascadae*) - Cascades of Oregon and Washington
Southern torrent salamander (R. *variegatus*)- Coastal Oregon (southern) and California (northern)

All species in this complex (formerly Olympic Salamander, Rhyacotriton olympicus) occur in association with Small, cold (46° to 54° F in summer) streams, especially in mossy gravel or splash zones of rocky, tumbling brooks. They are sensitive to increased temperature and sedimentation. Therefore, the primary mitigation measure for this group is protection of small streams, including headwaters, through buffers on each side of designated sites.

(c) Tailed Frog - Tailed frogs, like Olympic salamanders, occur in small, cold streams and are very sensitive to temperature. The primary mitigation measure for this species is protection of headwater streams through buffers designated on each side of the streams. Buffers provided under the Riparian Habitat Conservation Areas guidelines will maintain cool temperatures and will reduce sedimentation. Such buffers should provide adequate mitigation for this species.

(3) Birds:

(a) Bufflehead - Buffleheads nest in tree cavities in riparian zones at low elevation. They are associated with ponds, lakes, streams, and rivers. Protection of forest cover along streams, as in the Riparian Habitat Conservation Areas, will likely lead to long-term maintenance of nesting and foraging habitat.

(b) Harlequin Duck - Harlequin ducks are primarily associated with high elevation mountain streams. They are sensitive to human disturbance and water quality. Riparian Habitat Conservation Areas, in conjunction with large areas protected in congressionally designated Wilderness and Habitat Conservation Areas, will likely provide high quality water and undisturbed nesting sites. Road closures may be important in some locations to reduce disturbance; in such cases, road closure plans must be developed and implemented as part of the watershed analysis for the Riparian Habitat Conservation Areas (see Appendix 5-K).

(c) Northern Goshawk - Riparian Habitat Conservation areas will benefit goshawks, but will not fully provide for viability. Benefits from Riparian Habitat Conservation Areas will be most significant on the Olympic Peninsula and the Cascades of Oregon and Washington. Additional measures for goshawks are discussed below, and full mitigation measures are discussed in Mitigation Step 4. We recommend completion and implementation of the Forest Service's Pacific Northwest Region management direction and inventory protocol for northern goshawk currently in preparation (USDA 1992b). The purpose of the direction is to protect known active nest sites until the Forest Service, working with other agencies, can determine the species' actual habitat requirements (letter dated October 1, 1992, from Forest Service, Pacific Northwest Regional Directors of Fish, Wildlife, and Botany, and Timber Management, to Forest Supervisors).

(4) Mammals:

(a) American Marten (Oregon Cascades) - American martens use riparian areas for foraging and for selection of resting sites in large standing trees or in piles of woody debris. Riparian buffers will protect potential habitat in riparian zones and will contribute to long-term provision of snags and logs. In conjunction with Alternative B, riparian habitat protection will be particularly important in the Coast Range and Cascades of Oregon. Mitigation options for American marten in other parts of its range in the Pacific Northwest is further discussed under Mitigation Steps 4 and 6, below.

(b) Fisher (populations in California and southern Oregon, and northern Oregon and Washington) - Fishers use a wider range of habitats than those used by American martens and are able to forage in early-successional forest with dense overhead cover, as in brushy cutover or burned forest. However, they are sensitive to forest fragmentation when patches of forest are isolated by extensive open areas. Large snags (:*20 inches dbh) are important as maternal den sites. The Riparian Habitat Conservation Areas will likely provide cover and large snags in the forest matrix between Habitat Conservation Areas and will thus substantially enhance the distribution of fisher habitat. Other considerations for mitigation options for fisher are discussed under Mitigation Step 6, below.

(c) Red Tree Voles (*Arborimus longicaudus and A. pomo*) - Distributions of both species of red tree vole are poorly known. Studies are needed to better understand their relative abundance in different forest types and to delineate their geographic distribution, although such studies are not essential components of this mitigation step. Both species of red tree vole are thought to have very limited dispersal capability. Thus, fragmentation of forest canopy habitat in the forest matrix (outside old-growth protection areas such as Habitat Conservation Areas) could be a concern under Alternative B, especially in the Oregon Coast Range. However, buffers along steams in the Riparian Habitat Conservation Areas should alleviate much of this potential concern by providing connectivity between many of the Habitat Conservation Areas and other reserves. Maintenance of forest corridors of stands averaging

at least 11 inches dbh and at least 40 percent canopy closure as required by the 50-11-40standard for spotted owl dispersal habitat in the Final Environmental Impact Statement Alternative B, between Riparian Habitat Conservation Areas and across ridgetops, may further facilitate dispersal between watersheds. Although forest stands averaging 11 inches dbh and 40 percent canopy closure likely do not provide optimal breeding habitat, we believe that such stands would provide at least some dispersal habitat linking watersheds.

Mitigation Step 4 -Standards and Guidelines for Marbled Murrelet

a. Standards and Guidelines for Marbled Murrelet.

The marbled murrelet is listed by the Fish and Wildlife Service as a threatened species. These proposed standards and guidelines for management of marbled murrelets and their habitat are intended to be interim in nature and are based on the Scientific Analysis Team's professional judgment, which in turn was based on consultation with experts on the species and the very limited published information available.

We anticipate that ongoing planting efforts for conservation of the marbled murrelet (such as those in preparation by the Fish and Wildlife Service's Recovery Team, and the Forest Service's Marbled Murrelet Conservation Assessment Team) will produce management plans for marbled murrelets and their habitat that will supersede these interim standards. Our intent is to preserve options for management of marbled murrelet habitat until these plans are in place.

(1) Habitat:

(a) Identify all suitable habitat, regardless of occupancy by marbled murrelets, within 35 miles of marine environments in California and Oregon south of State Highway 42 and within 50 miles of a marine environment in the remainder of Oregon and Washington, This zone represents a geographical area influenced by marine air masses and likely encompasses nearly all, if not all, of the suitable marbled murrelet habitat. Nesting habitat, used here interchangeably with the term suitable habitat, is of primary concern and is defined as old-growth conifer forest stands, or mature forest stands with individual trees ~32 inches dbh. Stand size is not an issue in this definition; stand size criteria should not be used to eliminate stands from consideration. The definition for suitable habitat is broad and for some National Forests habitat remains unmapped. It is, therefore, essential to complete the following tasks:

- The above definition of suitable habitat must be refined for each National Forest within the range of the marbled murrelet in cooperation with the U.S. Fish and Wildlife Service and the respective state wildlife agencies as necessary to fit specific habitat types used by murrelets across the range of the species.

- Each National Forest within the range of the marbled murrelet shall map suitable marbled murrelet habitat on that Forest.

(b) Stop all ongoing projects under contracts or other legally binding agreements that may affect suitable murrelet habitat. This cessation of activity shall continue until completion of consultation between the Forest Service and the Fish and Wildlife Service on proposed projects that may affect this species, as required under Section 7 of the Endangered Species Act. Projects shall then be modified as indicated by that consultation. Such consultation may result in cancellation of some projects.

(c) In the case of all other other ongoing or proposed projects or activities without contracts or other legally binding agreements, do not remove or modify the tree canopy in suitable habitat. Ongoing or proposed activities may proceed when a conservation strategy or recovery plan is implemented, and provided that the activities are consistent with the conservation strategy or recovery plan.

(d) Identify and delineate habitat recruitment stands (younger forest stands deemed likely to develop into suitable murrelet habitat) within 35 miles of the coast in California and Oregon south of State Highway 42 and within 50 miles of a marine environment in the remainder of Oregon and Washington. No timber cutting shall take place in such habitat recruitment stands so long as these interim standards and guidelines are in effect.

There appears to be consensus among experts on the marbled murrelet that protection of all currently suitable marbled murrelet habitat alone would be insufficient as a long-term management strategy. A conservation strategy for marbled murrelet that does not provide for recruitment of nesting habitat will not ensure that nesting habitat and conditions conducive for successful reproduction (those habitat components that are in National Forests and contribute to viability) will be provided.

It seems logical to assume that nesting habitat may limit marbled murrelet populations. Therefore, it is prudent for the interim to ensure that forest stands that will develop into nesting habitat are retained in sufficient amounts and appropriate locations. The exact amount of recruitment habitat necessary for a long-term conservation strategy or recovery plan is not known, so precise standards for selection of replacement habitat are not now available. Although new insights from ongoing studies and planning team efforts will likely result in modification, we believe that the following standards and guidelines, if adopted, will ensure that adequate amounts of forest stands which are available to develop into nesting habitat are protected until a recovery plan is adopted.

The intent of the standards and guidelines for delineating stands as recruitment habitat is to prevent further fragmentation of forests adjacent to present nesting habitat for marbled murrelets, buffer suitable habitat from edge effects, and preserve options to allow such stands to grow into nesting habitat. We concluded that it is neither possible nor prudent, given the present state of knowledge, to provide standards and guidelines that address site specific variation in arrangements and quality of younger stands. We expect there will be places on the landscape where the standards and

guidelines for delineating recruitment habitat cannot be applied exactly as outlined; Where that situation exists, we expect that selection of recruitment habitat will be made in a manner that best meets the intent of the guidelines as stated above. Selection of all recruitment habitat shall be made with interagency participation and cooperation.

Identification and Definition of Habitat Recruitment Stands:

1. Amounts of habitat recruitment stands equivalent to 50 percent of the total amount of existing suitable habitat outside Category 1 and 2 Habitat Conservation Areas (as described in the Interagency Scientific Committee's Conservation Strategy) and congressionally designated Wilderness will be delineated outside Category 1 and 2 Habitat Conservation Areas and such Wilderness. For example, if in a National Forest 60,000 acres of the existing suitable habitat for marbled murrelets occur outside Wilderness and Category 1 and 2 Habitat Conservation Areas, then 30,000 acres of habitat recruitment stands will be delineated outside Category 1 and 2 Habitat Conservation Areas and Wilderness. All younger forest stands inside Category 1 and 2 Habitat Conservation Areas and Wilderness within the range of the marbled murrelet are already protected and have the potential to develop into nesting habitat. Habitat recruitment stands should be as contiguous as possible and (where the stands exist)100 acres or more in size. Recruitment stands should be well distributed and adjacent to many nesting stands rather than concentrated around a few stands.

2. First priority for delineation of habitat recruitment stands shall be given to stands adjacent to suitable habitat with known occupancy by marbled murrelets.

3. After first considering the priority for delineation of habitat recruitment stands adjacent to occupied sites, priority for selection of habitat recruitment stands shall be given to those watersheds where an analysis indicates that suitable habitat for marbled murrelets comprises less than 30 percent of the watershed. The Fish and Wildlife Service in the Status Review for marbled murrelets indicated that marbled murrelets were found more often when the percent of old, growth/mature forests makes up over 30 percent of the landscape (I4amer and Cummins 1992). Our objective here is to preserve options for planning teams to incorporate key stands into a recovery plan or conservation strategy that will likely improve the future quantity, distribution, and quality of nesting habitat for marbled murrelets.

4. Priority for selection of habitat recruitment stands among various-aged stands shall be given to old-growth or mature coniferous stands that will likely develop murrelet habitat characteristics in the shortest time period. If such stands are not available in an area where marbled murrelet occupancy has been determined, the next oldest and/or largest stands shall be selected. Stands where the average dbh is smaller than 16 inches shall not be selected as recruitment stands.

5. Habitat recruitment stands should be selected considering their potential for buffering adjacent suitable habitat. This is especially significant where such stands are adjacent to occupied sites. In such cases recruitment stands should be selected to minimize danger of windthrow and edge effects to the existing nesting habitat.

6. For stands of suitable habitat known to be occupied by marbled murrelets and for which it is not possible to delineate recruitment habitat that buffers the stand, either because stands meeting the above standards for recruitment habitat did not exist or acreage amounts for delineation (that is, the 50 percent guideline discussed in paragraph 1 above) have been met, it will be necessary to delineate additional buffers. Such buffers shall consist of stands where the average dbh is at least 10 inches. For occupied stands of suitable habitat greater than 100 acres in size, the buffer should be at least 300 feet wide. Where the occupied stands of suitable habitat is less than 100 acres, the buffer shall be at least 600 feet wide. Inasmuch as possible, buffers should completely surround the suitable habitat. Modification of the buffers shall be avoided until a recovery plan or a conservation strategy for marbled murrelets is implemented.

(2) Surveys:

(a) Within suitable habitat and within 35 miles of the coast in California and Oregon south of State Highway 42 and within 50 miles of a marine environment in the rest of Oregon and in Washington, all surveys conducted for marbled murrelets shall follow current protocol for intensive surveys adopted by the Pacific Seabird Group (Ralph and Nelson 1992). Under that protocol a minimum of two years of survey should be conducted to confirm absence of marbled murrelets. Protocols should be reviewed and updated annually by an interagency body.

(b) Conduct transect surveys in California and Oregon, south of State Highway 42, beyond 35 miles from marine environments. This area is included in the descriptions of the range of marbled murrelets but is an area where marbled murrelet sightings have not been documented. There was disagreement between experts contacted as to whether marbled murrelets occur within this area. Transect surveys should be conducted in forest stands with the same structural attributes as those stands that meet the definition of suitable marbled murrelet habitat closer to marine environments. These transect surveys are needed to ascertain the actual range and distribution of marbled murrelet habitat. If marbled murrelets are detected beyond 35 miles from the coast in southern Oregon and northern California, the intensive surveys following the current protocol as described in paragraph 1 above shall be conducted. This would expand the area over which intensive surveys are to be conducted. If murrelets are not detected it may be appropriate to redefine the range,

(3) Seasonal Restrictions:

Activities that may not affect suitable habitat but have the potential to disturb nesting activity of marbled murrelets should be implemented based on the following:

(a) Management activities within a 1/4-mile radius of known occupied sites should be restricted from April 1 to September 15 if, after a review of the specific activity and the landscape by a qualified wildlife biologist, the activity is determined to have the potential to disturb marbled murrelet nesting activity. Potentially-disturbing activities include, but are not limited to, activities resulting from issuance of permits for road rights-of-way, felling in forest stands not suitable for nesting by marbled murrelets, road construction or reconstruction, blasting, yarding, operation of heavy equipment, and mining operations.

(b) Within the zone 35 miles from marine environments in California and Oregon, south of Oregon State Highway 42, and within 50 miles of marine environments in the rest of Oregon and Washington, restrict potentially disturbing management activities (as described above) within 1/4 mile suitable habitat unless absence of marbled murrelets has been determined through protocol surveys.

(4) Adaptive Management:

(a) These guidelines should be reviewed by an interagency body annually or more frequently if warranted for adaptive management considerations.

(b) New research information concerning effects of disturbance on marbled murrelet nesting behavior, suitable stand size for murrelet management areas, and survey protocol should be incorporated into these guidelines as they become available.

b. <u>Other Species Benefited by Standards and Guidelines for Marbled Murrelet</u>

The following species whose viability is at risk under Alternative B of the Final Environmental Impact Statement are likely to be protected if they occur within areas protected under the guidelines for Riparian Habitat Conservation Areas or marbled murrelets. It seems likely that much of the distribution of these species is included in such protected areas.

(1) Nonvascular Plants:

(a) *Teloschistes flavicans* (Lichen) Only one site is known for this species, Cape Lookout, Oregon, adjacent to land managed by the Forest Service. It occurs in the coastal fog belt in large, old, coastal Sitka spruce forest, it may occur in National Forests but surveys are needed.

(b) *Herbertus sakuraii* (Liverwort) This species is extremely rare, occurring only on Saddle Mountain, Coast Range, Oregon. Fog drip environment is significant. This species occurs in coastal Sitka spruce fog belt, There is a need to survey for the species on Mt. Hebo, Onion Mt., and Sugarloaf Mt.,

Coast Range, Oregon, and to protect habitats from ground disturbance if found. Other liverwort species associated with the same habitats and ranges as H. sakuraii, and likely to be equally benefited by mitigation options for marbled murrelet, include *Iwiatsukella leucotricha, Radula brunnea, Tritomaria quinquedentata,* and *Apometzgeria pubescens.*

(c) *Bartramiopsis lescurii* (Moss) This species occurs in low to mid elevations the west slopes of the Olympic Mountains on wet organic soils. It is extremely rare. There is a need to protect from ground disturbance known sites and additional sites as found. As an interim measure, mitigation options for marbled murrelet will help protect known sites for this species.

(d) *Pleuroziopsis ruthenica* (Moss) This species is included in the species group with Bartramiopsis lescurii above, with the same conditions and benefits from mitigation options for marbled murrelet.

(e) *Collybia racemosa* (Fungus) This mushroom is rare, known to occur in six sites in the Quinault Research Natural Area in Washington in well established old-growth forest. It is perhaps more common in coastal old-growth forests, but needs surveys, studies, and inventories. In the interim, mitigation measures for marbled murrelet will help protect known sites for this species.

(f) *Albatrellus caeryliopus* (Fungus) This mushroom occurs mostly at lower elevations in the Olympic Peninsula, Cortez island, and Mt. Hood National Forest. Other mushroom species sharing similar habitats and ranges that would also benefit from mitigation options for marbled murrelet are *Catathelasma ventricosa* (widely distributed), *Cortinarius boulderensis*, *Cortinarius cyanites, Cortinarius olympianus, Cortinarius rainierensis* (only known site is Barlow Pass and Mount Rainier), *Cortinarius tabularis* (occurs on spruce trees in Quinault Research Natural Area, Washington), *Cortinarius valgus* (occurs on spruce trees in Quinault Research Natural Area, Washington), *Cortinarius variipes*, and *Gomphus kauffmannii*. Although not required as a standard, additional surveys for all of these species would better define their distribution and the need for any additional protection. However, in the interim, mitigation measures for marbled murrelet will help protect known sites for this species.

(2) Amphibians:

Clouded Salamander - This species requires large (>20 inches in diameter) down logs of mid-decay classes (decay classes 2-4 preferred) with sloughing bark. The species is well distributed within its range, which closely coincides with that of the northern spotted owl in California and Oregon (clouded salamanders do not occur in Washington). Late-successional forest protected for marbled murrelets, Riparian Habitat Conservation Areas, Alternative B as described in the Final Environmental Impact Statement (or its modification as presented in Chapter 3), and existing Land and Resource Management Plan standards and guidelines for management of down logs will likely provide sufficient habitat to assure well distributed viable populations of this species in National Forests within the range of the northern spotted owl.

(3) Birds:

Northern Goshawk - Although some protection for northern goshawk habitat is afforded by the Riparian Habitat Conservation Areas discussed above, additional protection is needed to help ensure viability within the range of the northern spotted owl. Under the interim marbled murrelet standards and guidelines, nearly all of the mature or old-growth forest in the Olympic National Forest that is otherwise unprotected outside of Habitat Conservation Areas under Alternative B of the Final Environmental Impact Statement will be protected, Therefore, nearly all potential nesting habitat in the Olympic National Forest will be protected from timber harvest. The Olympic Peninsula is an area of particular concern because northern goshawks are believed to be relatively isolated there, they occur in low numbers, and their habitat requirements have not been well documented. Experts strongly suspect that old-growth forests are vital for nesting. Protection of habitat under the combination of Alternative B of the Final Environmental Impact Statement, Riparian Habitat Conservation Areas, and marbled murrelet guidelines provides broad latitude for natural catastrophes and uncertainties in knowledge.

In addition, the bird expert panel recommended the following mitigation measures: save mistletoe trees, especially on the east slope of the Cascades, protect nest stands of pairs located outside of Habitat Conservation Areas, and conduct further research on the distribution and ecology of the species throughout its range. The following forest management activities would help conserve suitable habitat conditions for the species: retain the upper forest canopy at known or suspected nest sites; retain down wood and logs for prey, principally squirrel species; and manage stands for understory removal and canopy retention. We believe that such conditions would be provided under Mitigation Steps 1 through 4.

(4) Mammals:

American Marten (populations in Olympic Peninsula and Oregon Coast Range) - with northern goshawk, protection for American marten is afforded by the Riparian Habitat Conservation Areas discussed above. However, additional protection is needed for American marten habitat to help ensure viability within the range of the northern spotted owl. Interim guidelines for marbled murrelets on the Olympic Peninsula will also provide substantial benefit to protection of American marten habitat on the Olympic Peninsula, especially in combination with Alternative B of the Final Environmental Impact Statement, and watershed protection. Murrelet guidelines plus Riparian Habitat Conservation Areas will also contribute to American marten viability within the range of murrelets on the Oregon Coast Range and coastal northern California.

c. Adoption, of Recovery Plan for Marbled Murrelet

Once a final recovery plan for marbled murrelets is adopted, the new standards and guidelines must be evaluated to determine whether the set of other species protected by the interim standards and guidelines will still be adequately protected. If an area of habitat is removed from protection, the area should be surveyed for the species listed in this section prior to undertaking any site-disturbing activity and, if necessary, site-specific management prescriptions should be prepared to meet the habitat requirements of these species.

Mitigation Step 5 - Standards and Guidelines for Rare, and Locally Endemic Species.

As with the set of species listed in the above category, the following rare and locally endemic species are likely to be assured viability if they occur within Habitat Conservation Areas conserved by Alternative B of the Final Environmental Impact Statement, Riparian Habitat Conservation Areas, or areas covered under the marbled murrelet guidelines. However, there might be occupied locations outside these conservation areas that will be important to protect as well. We therefore recommend that protocols for surveys be developed that will ensure a high likelihood of locating these occupied sites. Prior to ground disturbing activities, surveys using tile protocol must be conducted within the known or suspected ranges and within the habitat types or vegetation communities occupied by the species. When located, the occupied sites need to be protected as indicated below.

(1) Nonvascular Plants:

(a) *Ptilidium californicum* (Liverwort) This species is rare and has a very limited distribution in old white fir forests with fallen trees. It occurs on trunks of trees at about 5000 feet elevation. Mitigation options include finding locations and maintaining stands of over mature white fir at about 5000 feet elevation for inoculum and dispersal along corridors; and studying specific distribution patterns. Protect known occupied locations if distribution patterns are disjunct and highly localized, by deferring timber harvest and avoiding removal of fallen trees and logs.

(b) *Ulota megalospora* (Moss) This species occurs in northern California and southwest Oregon. It is best developed (locally abundant) in very old stands of tanoak, Douglas-fir, and other conifer species further north, but is generally scarce throughout its range. The species is poorly known ecologically. Mitigation activities include conducting basic ecological studies, and surveying for presence, particularly in Oregon. Protect known occupied sites if distribution patterns are disjunct and highly localized. Defer timber harvest or other activities which would not maintain desired habitat characteristics and population levels.

(c) *Brotherella roellii* (Moss) This very rare species is endemic to the Washington Cascades north of Snoqualmie Pass. It occupies rotting logs in low to mid elevation old-growth stands having dense shade, closed canopies, and high humidity. Mitigation options include locating specific populations and protection of large decay class 3, 4, and 5 logs and >70 percent canopy closure. Defer management activities conflicting with maintaining suitable habitat characteristics and known population levels.

(d) *Buzbaumia piperi, B. viridis, Rhizomnium nudum, Schistostega pennata*, and *Tetraphis geniculata* (Mosses) Most of these species are fairly rare (the exception is *B. piperi*). They occur on rotten logs and some organic soil, and are shade-dependent, occurring in old-growth forests. *S. pennata* occurs only in mature western red-cedar forests in the Olympic National Forest and in Washington Cascades. Mitigation activities include surveying to determine presence and distribution; and, where located, maintaining decay

class 3, 4, and 5 logs and >70 percent closed-canopy forest habitats for shade. Shelterwood and thinning prescriptions for timber harvest will cause their demise, as logs dry out.

(e) *Aleuria rhenana* (Fungus) This mushroom is widely distributed but rare and little known throughout its range, known from one collection from Mt. Rainier National Park. It is a conifer litter decomposer. Mitigation activities include conducting ecological studies and surveys to determine localities. Protect known populations if surveys continue to indicate that the population is rare. Defer ground disturbing activities.

(f) *Otidea leporina, O. onotica*, and *O. smithii* (Fungi) These mushrooms occur in conifer duff, and are widespread in distribution but uncommon. They are dependent on older age forests. Specific mitigation options include protecting older forests from ground disturbance where the species are located.

(g) *Polyozellus multiplez* (Fungus) Ecologically, this mushroom was considered by the nonvascular expert panel in the same species group as Albatrellus caeryliopus and others, listed above under species aided by marbled murrelet mitigation measures. However, *P. multiplez* occurs in higher elevation of the Cascades in silver fir and mixed conifer (and is thus outside the range of marbled murrelet mitigations). It can be locally abundant and is mychorrizal species important to forest health. Like its group associates, it is a good indicator of old-growth forests. Mitigation activities for this species include conducting surveys to define its distribution, and studies to assess its habitat requirements.

(h) *Sarcosoma mexicana* (Fungus) This mushroom occurs in deep conifer litter layers in older forests. It is uncommon to rare and is found in the Oregon and Washington Coast Range into British Columbia. Mitigation activities include surveying for locations and protecting deep litter layers of older forests where found. Defer prescribed burning of understory or other activities which would not retain a deep litter layer.

For all of the plants listed in this mitigation step, and for those listed in the next step, we recommend that Regional ecologists or botanists should: (1) maintain spatially explicit data base of all known sites in National Forests, and (2) develop species or area management plans, to be implemented under the guidance of the regional botany programs.

(2) Invertebrates:

Although lack of information prevented us from analyzing mitigation needs for specific invertebrate species, Olson (1992) underscored the need for surveys for species that are rare or locally endemic. Within the range of the northern spotted owl, invertebrates are noted for their high frequency of endemism (species found nowhere else) and restricted ranges. Centers of invertebrate biodiversity include, in particular, the Olympic Peninsula and its south coast, the southern Oregon Cascades, the Klamath physiographic province, several isolated volcanic peaks

including Mt. Hood and the Three Sisters in the Oregon Cascades, and the coastal forests of Oregon and California. In addition, some species are poor dispersers or rely on special habitats including decaying wood or aquatic environments.

Frest and Johannes (1991)identified endemic species complexes of terrestrial molluscs (bivalves and snails) in the west coast states, particularly limited to the areas from the Cascades crest to the coast. As summarized by Anthony et al. (1992:348-349).

> "Within the owl's range, there are three distinct land snail provinces. The Oregon province extends from coastal British Columbia just into extreme northern California; the Washington province extends east from the Cascades crest; and the California province is coastal northern California."
>
> "There are sizable endemic species clusters in the land snail genera *Monadenia, Trilobopsis, Megomphix, Haplotrema, Vespericola* and *Hemphillia.* Physical factors limiting their distribution include geologic history, substrate (some are restricted to limestone, for example, the candidate *Monadenia* troglodytes, endemic to the Siskiyou Mountains and the area around Mt. Shasta), moisture requirements, and cover. In general, land snails in this region require relatively undisturbed cover. Most thrive in lowland forests and the areas around springs. Many species seem to be associated specifically with lowland old-growth forests, and most are extremely limited in distribution. The malone jumping slug, *Hemphillia malonei,* occurs only on the slopes of Mt. Hood. The genus *Megomphiz* is known only from sites in the Puget Sound region and in the Willapa Hills, of southwest Washington. In recent years, only one site has been found to support *Megomphix hemphilli*."

Frest and Johannes (1991) also identified complexes of endemic freshwater molluscs, although the aquatic complexes are not part of our current analysis.

Anthony et al. (1992:355-356) also discussed the occurrence and distribution arthropods in old-growth forests of the Pacific Northwest:

> "First, many species are flightless, which means that their dispersal capabilities are limited. Second, the flightless condition is believed to reflect habitat stability and permanence over a long time period. Some old forest associates have highly disjunct distributions and are found only in undisturbed forests. They share similar distribution patterns on the west side of the Cascade Mountains from British Columbia south to southern Oregon and northern California (i.e., they are endemic to the Pacific Northwest). Many the species native to this region have not been described or named, and the number of known species probably represents less than half of the estimated species (J. Lattin, Oregon State University, pers. comm.)."

Mitigation guidelines for Riparian Habitat Conservation Areas and marbled murrelets would aid in conserving species in biodiversity centers and other areas, as "Habitat Conservation Areas established for owls probably will not capture the full extent of invertebrate species richness. The protection of suitable owl habitat in intervening areas as proposed in Alternative D of the Final Environmental Impact Statement will help :preserve more species distributed over the landscape, but the effectiveness of this provision will be dependent upon the number, size, and isolation of the selected habitat fragments" (Olson 1992:4-5).

Olson (1992) also noted that small fragments of primary forest might serve reserves for populations of old-growth invertebrates. "In regions with a high proportion of species with restricted ranges, such as the Olympic Peninsula, the coastal forests of Washington, Oregon, and California, and the Klamath Province, increased emphasis on preserving small fragments of [old-growth forest] habitat may be warranted" (Olson 1992:15). Such fragments would be provided under combination of the Riparian Habitat Conservation Areas and marbled murrelet guidelines. Elsewhere, some species of invertebrates can be provided for by retaining canopy coverage, providing log and slash piles, and maintaining a moist forest floor environment.

Understanding the true effectiveness of conserving the invertebrate fauna with mitigation measures proposed in our report awaits further surveys, inventories, and studies. Olson (1992:12) proposed using a survey protocol for rapidly identifying biologically unique areas, and in taking advantage of "natural experiments" to investigate the relationships of invertebrate populations to different growth stages and variously fragmented forest patches and landscapes. He presented an excellent research agenda for such studies (too lengthy to repeat here), which included testing and use of invertebrate species as environmental indicators. This agenda should be pursued.

(3) Amphibians:

(a) Larch Mountain Salamander - Because of the narrow distribution of this species, mostly within the Columbia River Gorge, primary emphasis should be to survey and protect all known sites. Sites must be identified based on fall surveys conducted using a standardized protocol. Known sites are included within boundaries of conservation areas and under these guidelines, are not to be disturbed. Surveys are needed at additional sites in the forest matrix along the Columbia River Gorge. Key habitat is mossy talus protected by overstory canopy. Avoiding any ground-disturbing activity that would disrupt the talus layer where this species occurs is the primary means of protection. Once sites are identified, maintain 40 percent canopy closure of trees within the site and within a buffer of at least the height of one site-potential tree or 100 feet horizontal distance, whichever is greater, surrounding the site. Larger buffer widths are appropriate upslope from protected sites on steep slopes. Partial harvest may be possible if canopy closure can be retained; in such cases logging must be conducted using helicopters or high-lead cable systems to avoid disturbance of the talus layer.

(b) Siskiyou Mountain Salamander - This species occurs within an extremely narrow range on the Rogue River, Siskiyou, and Klamath National Forests. Its range does not fall within any Habitat Conservation Areas in Oregon. Additional surveys conducted using a standardized protocol must be undertaken to delineate range and identify subpopulations. All populations must be protected by delineating an occupied site and avoiding disturbance of talus throughout the site, especially on moist, north-facing slopes, particularly in Oregon where Habitat Conservation Areas do not incorporate species' range. Because this species seems to require cool, moist conditions, a buffer of at least the height of one site-potential tree or 100 feet horizontal distance, whichever is greater, surrounding the site, must be retained around the outer periphery of known sites. Overstory trees must not be removed within the boundary of this buffer.

(c) Shasta Salamander - This species is very narrowly distributed, occurring only in localized populations on the Shasta-Trinity National Forest. Only a small part of its range is included within a Habitat Conservation Area under Alternative B. It occurs in association with limestone outcrops, protected by an overstory canopy. All known and future localities must be delineated and protected from timber harvest, mining, quarry activity, and road building within the delineated site, and a buffer of at least the height of one site-potential tree or 100 feet horizontal distance, whichever is greater, should surround the outcrop. Additional surveys, conducted using a standardized protocol, must be undertaken to identify and delineate all occupied sites within the species' potential range.

Mitigation Step 6 - Additional Standards and Guidelines for Other Species in the Upland Forest Matrix.

As with the above sets of species under Mitigation Step 5, the following species whose viability is considered to be at risk under Alternative B of the Final Environmental Impact Statement are likely to be assured viability if they occur within Habitat Conservation Areas of Alternative B of the Final Environmental Impact Statement, Riparian Habitat Conservation Areas, or areas covered under the marbled murrelet guidelines. However, if they are located outside of such areas, additional mitigation measures would be needed to avoid increasing risk to viability. These measures are discussed, by species, below.

(1) Amphibians:

Del Norte Salamander - This species occurs in talus slopes protected by overstory canopy that maintains cool, moist conditions on the ground. The species is a slope-valley inhabitant, and sometimes occurs in high numbers near riparian areas. Riparian Habitat Conservation Areas, in combination with Habitat Conservation Areas and other reserves, will offer some protection to the species but significant numbers also occur in upland areas. Additional mitigation options in this upland matrix include identifying locations (talus areas inhabited by the species) by using standardized survey protocol, then protecting the location from ground-disturbing activities. Designate a buffer of at least the height of one site-potential tree or 100

feet horizontal distance, whichever is greater, surrounding the location. Within the site and its surrounding buffer, maintain 40 percent canopy closure and avoid any activities that would directly disrupt the surface talus layer. Partial harvest within the buffer may be possible if 40 percent canopy closure can be maintained; in such cases, tree harvest must be conducted using helicopters or high lead cable systems to avoid compaction or other disturbance of talus.

(2) Birds:

(a) White-headed Woodpecker, Black-backed Woodpecker, Pygmy Nuthatch, and Flammulated Owl - These species will not be sufficiently aided by application of mitigation measures for riparian habitat protection or for marbled murrelets alone. They all occur on the periphery of the range of the northern spotted owl on the east slope of the Cascade Range in Washington or Oregon. Additionally, white-headed woodpecker and flammulated owl occur in the Klamath Province in northwestern California and southwestern Oregon. The viability of all four species within the range of the northern spotted owl was rated as a medium risk on National Forests, although they each are much more widely distributed elsewhere.

Apply the following mitigation guidelines to ensure that the distribution and numbers of all four species do not severely decline on National Forests within the range of the northern spotted owl. These guidelines apply to the forest matrix outside designated habitat for the northern spotted owl and Riparian Habitat Conservation Areas. Maintain adequate numbers of large snags and green tree replacements for future snags within the four species' ranges in appropriate forest types. Where feasible, green tree replacements for future snags can be left in groups to reduce blowdown. Specifically, we recommend that no snags over 20 inches dbh be marked for cutting. We recognize, however, that safety considerations may prevent always retaining all snags. Use of standardized definitions of hazard trees is required. For the longer term, provide for sufficient numbers of green trees to provide for the full (100 percent) population potential of each species.

As depicted by Neitro et al. (1985), the 100 percent population potential for white-headed woodpeckers is 0.60 conifer snags (ponderosa pine or Douglas-fir) per acre in forest habitats; these snags must be at least 15 inches dbh (or largest available if 15 inch dbh snags are not available) and in soft decay stages (see Neitro et al. 1985 for specifics), and must be provided in stands of ponderosa pine and mixed pine-Douglas-fir. The 100 percent population potential for black-backed woodpeckers is 0.12 conifer snags per acre in forest habitats; these snags must be at least 17 inches dbh (or largest available if 17 inch dbh snags are not available) and in hard decay stages, and must be provided in stands of mixed conifer and lodgepole pine in higher elevations of the Cascade Range. Provision of snags for other cavity-nesting species, including primary cavity-nesters, must be added to the requirements for these two woodpecker species. Site-specific analyses, and application of a snag recruitment model (specifically, the Forest Service's Snag Recruitment Simulator) taking into account tree species, diameters, falling rates, and decay

rates, will be required to determine appropriate tree and snag species mixes and densities. If snag requirements cannot be met, then harvest must not take place.

As identified by the expert panel, black-backed woodpeckers also require beetle-infested trees for foraging; some such trees should be provided in appropriate habitat, and sanitation harvest of all such trees would be detrimental to the species. More information is needed on habitat use, seasonal occurrence, and use of forest age classes and burns, for the black-backed woodpecker.

Pygmy nuthatches use habitats very similar to those of white-headed woodpecker. Pygmy nuthatches require large trees, typically ponderosa pine within the range of the northern spotted owl, for roosting. Provision of snags for white-headed woodpeckers is assumed to provide for the needs of pygmy nuthatch, as no species-specific guidelines for the species have been developed. Additional information on ecology of pygmy nuthatch within the range of the northern spotted owl is needed to develop more precise guidelines.

Flammulated owls are secondary cavity-nesters and use cavities, in snags and live trees, created by woodpeckers or, less often, that occur naturally. We assume that standards and guidelines for snags and green tree replacements for woodpeckers and other primary cavity-nesting species, as provided by existing National Forest Land and Resource Management Plans and for the woodpeckers in this species group, would provide for flammulated owls.

(b) Great Gray Owl - Within the range of the northern spotted owl, the great gray owl is most common in lodgepole pine forests adjacent to meadows. However, it is also found in other coniferous forest types. In some locations, such as on the Willamette National Forest west of the Cascades Crest, at least some shelterwood harvesting seems to be beneficial for the species by opening up otherwise closed canopy cover for foraging. In doing so, consequences to species such as northern goshawk and American marten must be evaluated. Specific mitigation measures for great gray owl, within the range of the northern spotted owl, include the following: provide a no-harvest buffer of 300 feet around meadows and natural openings and establish 1/4-mile protection zones around known nest sites. Within one year, develop and implement a standardized protocol for surveys; survey for nest locations using the protocol. Protect all future discovered nest sites as previously described.

(3) Mammals:

(a) American Marten and Fisher - The level of habitat conservation provided by the combination of Alternative B of the Final Environmental Impact Statement, Riparian Habitat Conservation Areas, and marbled murrelet mitigation guidelines are generally sufficient so that additional standards and guidelines are not required to prevent the extirpation of American martens and fishers within the range of the northern spotted owl. However, we do recommend two additional actions for specific areas to help ensure future viability of these species.

First, the National Forests in California must finalize and implement their draft habitat capability model for fisher and American Marten. Implementation of this model would likely reduce information that will further reduce risks to viability in those National Forests. Forests in Oregon and Washington must retain existing management requirement areas for American marten for the same reason. However, adequacy of these practices must be reevaluated through the ongoing conservation assessment process or through special review. Monitoring and adaptive management are especially important for these species.

Second, populations of fishers are extremely low in northern Oregon and Washington. Harvest of American martens is permitted in these states, and accidental take of fishers cannot be avoided using kill-trap methods. To reduce risk of further loss of fishers, we recommend closure of all National Forests (within the overlapping ranges of American marten, fisher, and northern spotted owls) to kill-trapping of American martens until the rate of accidental take of fishers is determined to be insignificant. We recommend formation of an interagency group comprised of state furbearer biologists and Forest Service wildlife biologists to undertake this evaluation for both states.

(b) Lynx - Lynx are rare within the range of the northern spotted owl, occurring primarily in the Okanogan area of Washington. The lynx is currently listed by the Fish and Wildlife Service as a Category 2 candidate (a species for which additional information is needed to propose listing as threatened or endangered); A petition was filed to list the lynx as endangered within the northern Cascades of Washington, based on small population size, population isolation, and lack of adequate prey base (snowshoe hare). However, the Fish and Wildlife Service ruled that available information does not warrant listing the lynx in Washington (USDI 1992b).

Three primary habitat components for lynx are (1) foraging habitat (15-35 year old lodgepole pine) to support snowshoe hare and provide hunting cover, (2) denning sites (patches of >200-year old spruce and fir, generally acres), and (3) dispersal/travel cover (variable in vegetation composition structure). The major limiting factor is abundance of snowshoe hare, which in turn is limited by availability of winter habitat (primarily early-successional lodgepole pine with trees at least 6 feet tall). Past excessive trapping of lynx and incidental mortality of lynx from hunting of other species have depressed populations and may have been detrimental to local lynx populations in Washington (Washington Department of Wildlife 1991). Roads provide access to hunters and trappers and thus road density may be related to lynx mortality.

Alternative B as described in the Final Environmental Impact Statement, as well as existing higher elevation reserves, will provide denning habitat within protected forest stands in juxtaposition with early successional vegetation in the forest matrix. Connectivity between many of the denning patches will be provided by the network of buffers along streams under the Riparian Habitat Conservation Areas.

In addition, we propose development of site-specific timber harvest, reading,

and fire management plans in known lynx range. These plans should be developed in consultation with state wildlife agencies and should address: (1) minimizing road construction, closing unused roads, and maintaining roads to the minimum standard possible; (2) using prescribed fire to maintain forage for snowshoe hare in juxtaposition with hunting cover; (3) designating areas as closed to kill trapping of any furbearer to avoid incidental lynx mortality to maintain population refugia for lynx in key areas; (4) planning for kill trapping closure on a wider basis if data indicate a declining lynx population as a result of incidental trapping mortality; and (5) developing and implementing a credible survey and monitoring strategy to determine the distribution of lynx throughout its potential range.

Species for Which Information is Most Limited

The amount and quality of information available for old-growth associated species varies significantly from species to species. More information would be useful in developing conservation measures for all these species, including northern spotted owls which are probably the best studied. For this analysis, we have chosen to place the species in three broad categories based on the amount of information available. The first category includes the 459 species for which specific mitigation was described (Table 5-3). The second group includes species for which information was poor, but which are likely to be significantly protected by the mitigation measures due to overlap between their ranges or habitat requirements and the old-growth areas identified in the mitigation steps. The third group includes species for which information is most limited. No conclusion can be drawn about the protection of this third category of species.

In these last two groups, we identified 59 species of nonvascular plants, vascular plants, and terrestrial vertebrates. These are species which the expert panelists identified as lacking scientific studies and whose viability could not be ranked according to general life history attributes and distribution because of the lack of basic information. All 59 species, however, are thought to be closely associated with old-growth forests or components of old-growth forests.

An additional 149 species of invertebrates (58 molluscs and 91 arthropods) were identified from the contract reviews as closely associated with old-growth forests or old-growth forest conditions within the range of the northern spotted owl, or whose specific habitat conditions or future viability could be directly influenced by spotted owl habitat planning. Data were lacking for all 149 invertebrate species so that individual viability assessments under each of the five alternatives in the Final Environmental Impact Statement were not possible. All 149 species - and likely other invertebrate species not included in the contract evaluations - require further study for more specific analysis of potential viability effects.

Thus, in this report, we identified a total of 208 species (59 fungi, lichens, plants, and terrestrial vertebrates; and 149 invertebrates) for which information is most limited. Only 10 species of this total are vertebrates, all of which are mammals. Nine of the mammals are species of bats.

The conservation of old-growth forests under Mitigation Steps 1 through 6 listed previously might provide some of these 208 species with some degree of protection. Some overlap between each of their distributional ranges with those of the old-growth areas may exist. To examine the likelihood of protection, we identified a set of seven ecological conditions which reflected

general distribution or life history patterns suggesting some (unknown) degree of protection from Mitigation Steps 1 through 6. The seven ecological categories of conditions were:

1. Species which may be at least locally common to abundant;

2. Species that are rare to uncommon but are widespread;

3. Species that are locally endemic;

4. Species closely associated with the general types of old-growth forests and conditions afforded by the mitigation steps;

5. Species that are specialized to specific substrates (surfaces) or edaphic conditions (soil and ground conditions), especially those afforded by the mitigation steps;

6. Species occurring in high elevation forests, within the overall range of the northern spotted owl but generally in higher elevation forest types than those used by the northern spotted owl for nesting, roosting, or foraging; and

7. Species whose geographic range overlaps that of the northern spotted owl only along a fringe of the owl's range.

We assumed that habitat conditions for species identified in ecological categories 1 through 5 might be protected by the combination of Mitigation Steps 1 through 6. Species in categories 6 and 7 generally occur outside the ecological or distributional range of the northern spotted owl; and whereas their viability is still of direct concern in this evaluation, their persistence is much more influenced by factors other than those addressed in the spotted owl habitat management guidelines.

According to the results of this evaluation, 23 of the 59 plant and vertebrate species met at least one of the first five ecological conditions, leaving 36 of these species for which effects were truly unknown. The 36 species included 19 nonvascular plants, 8 vascular plants, and 9 mammals (Appendix 5-J).

Effects are also unknown for all 149 invertebrates. Appropriate study should identify the important role of each invertebrate species in old-growth ecosystem processes, and would help identify which set of species could serve as indicators of various aspects of the health of old-growth forests (Olson 1992).

There may be species that we did not identify in our evaluation or to whom we assigned a low risk, that, as more data accumulate, would show close association with late-successional and old-growth forests and that might put such species at viability risk. This is likely the case with at least some species of invertebrates and nonvascular plants. On the other hand, with further scientific study, inventory, and monitoring, some of the species identified in this report as potentially having their viability at risk might turn out to be at less risk than initially suggested. At this time it is impossible to determine without further study which, if any, species would fall into either of these categories. Surveys, research, monitoring, and an adaptive management approach would all be necessary to gather and account for such new information over time.

DISCUSSION AND CONCLUSIONS

Ensuring Effectiveness of the Mitigation Measures

We believe that the combination of (1) forest management standards and guidelines, (2) spotted owl habitat guidelines in Alternative B of the Final Environmental Impact Statement, or their modifications to account for increased risk from Bureau of Land Management management (see Chapter 3), (3) Riparian Habitat Conservation Areas, (4) habitat protection for marbled murrelet, (5) mitigation measures for rare and locally endemic species, and (6) mitigation measures for other species in the upland forest matrix, would collectively provide for a high likelihood of continued existence of well distributed fish habitat and plant and wildlife populations plus northern spotted owls on National Forests. Although it is not possible to predict effects on most invertebrate species, future security of this group is likely to be greatly enhanced under this scheme.

We also strongly urge the application of regional oversight and guidance to ensure consistent interpretation and application of these guidelines and mitigation measures across all pertinent National Forests. An example is the need for development and application of standardized inventory and survey protocols for some species; such protocols should be written by a technical group at the regional or inter-regional level.

Uncertainties of Information and Viability Projections

Ensuring long-term population viability means taking preemptive action to prevent currently secure species from becoming viability risks; identifying species currently at risk; instituting appropriate conservation strategies; and gathering new scientific information on species and ecological conditions where such information is lacking. We believe that these steps collectively constitute a necessary part of any scheme of ecosystem management.

Applying mitigation measures presented herein would provide preemptive actions to help prevent currently secure species from having their viability placed at risk in the future. The list of secure species are those on the short lists (Appendices 5-B, 5-D) that do not appear as viability concerns (Appendix 5-H). However, better inventories are still needed on vegetation conditions that can be used to project the extent, distribution, and trend of habitat for species that are secure and for those whose viability is at risk. Such inventories would also help determine the occurrence of scarce or declining ecological communities and special habitats, which our report addresses only indirectly. Similarly, we could not quantify the locations and frequency of catastrophic events, nor could we map specific locations of future management activities. Both of these factors added uncertainty in our attempt to project the distribution and abundance of habitat over time. We did, however, construct our mitigation steps to attain a high probability of providing for the viability of the species we addressed. This entailed qualitatively accounting for catastrophic events.

Uncertainties associated with identifying viability risk species and mitigation options include the degree to which factors are currently a threat, and the pace at which such threats can be offset by restoring habitat conditions. For many species, such quantitative analyses are not possible without further knowledge of specific habitat associations of species, demography of populations, and dynamics of habitat changes, including changes from anthropogenic (human-induced) and ecological (such as succession, fire regimes, etc.) factors. Uncertainties in projecting future

viability were recognized by the Scientific Analysis Team and by the expert panels, who depicted uncertainties as ranges of potential future viability effects.

Uncertainties associated with species lacking adequate scientific information underscore the need for basic life history and ecology studies, and inventories for presence and habitat associations. Studies and inventories are needed on a variety of plant, invertebrate, and some vertebrate species. Such basic data will allow agencies to move toward more credible, ecologically-based management that will sustain biological diversity and production of commodity renewable resources.

In particular, increasing scientific knowledge on invertebrates can help develop monitoring and adaptive management activities for management of old-growth forest ecosystems. For example, Olson, (1992: 27-28) noted that, "forest invertebrate assemblages can serve as excellent tools for adaptive management programs. The effect of harvesting schedules and management practices on local ecosystem vigor can be assessed rapidly, and appropriate changes can be made in a timely fashion. Invertebrates are also useful for long-term monitoring of ecosystem viability on both a local and regional scale." Olson presented a list of 14 potential invertebrate indicator taxa and species for monitoring old-growth forests ecosystems, from H.J. Andrews Experimental Forest on the west slope of the northern Oregon Cascades. An example from this list is the millipede *Harpaphe haydeniana* (Diplopoda: Xestodesmidae), a widespread species vital for nutrient cycling in the soil because it is a dominant decomposer of coniferous litter (also see Lattin and Moldenke 1992). Other potential invertebrate indicators presented by Olson (1992: 47-48) include species of camel crickets, sowbugs, weevils, true bugs, ground beetles, wood-boring beetles, cursorial spiders, mites, ants, and earthworms. This is an obviously rich and untapped area worthy of further study.

Toward Ecosystem Management

We emphasize the need to treat our viability evaluations and proposed mitigation measures as preliminary management hypotheses. All species that we identified as associated with old growth, and particularly those that we identified as having medium or high risk of extirpation, require further basic research, monitoring of habitat amount and distribution, and, in some cases, monitoring of specific population distribution, size, and trend.

This project is but an initial step in a larger process for supporting ecosystem management, planning, and evaluation. There is still a great deal of basic work to do to support ecologically-based land stewardship. There are no quick fixes given the complexities of natural environmental systems.

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